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THE SCALLOP AND ITS FISHERY.

BY ERNEST INGERSOLL.

THOUGH it had long previously been enjoyed by the shore-towns in New England, the introduction of the scallop as an edible into the New York markets is as recent as 1858 or '59. Now the annual product of the fishery, which is restricted in area and subject to much variation, amounts to something like 75,000 gallons in all, worth from twenty-five to thirty thousand dollars at first cost; and New York receives and dispenses about three-fourths.

The species of scallop in question is *Pecten irradians*, which is common in suitable places all along our coast. Besides this there are half a dozen other varieties, living at more or less depths, in the western Atlantic, one of which, the great *Pecten tenuicostatus* of the coast of Maine and the Bay of Fundy, was formerly highly valued by the people of that region, but now is too scarce to appear on the tables of even "the rich" except at rare intervals.

The fishery and methods of preparation for market of our scallops present several features of general interest, and I believe that in my study of the matter, a few years ago, as an agent of the Census Bureau, I was able to learn some new and suggestive particulars as to the habits of the mollusk.

Though occurring in a scattered way far to the northward, it is only between Cape Cod and New Jersey that any commercial scallop-fishery exists, save at a few points on the Southern coast, as at Morehead City, N. C., for a small local trade. Even along this limited extent the fishing is not continuous, but can be followed with regularity only in restricted areas of Buzzard's bay, Mass., Narragansett bay, R. I., in Peconic bay at the eastern

end of Long Island, and at a few minor points on the New Jersey coast. Long Island sound, New York bay, Sandy Hook and much of the Jersey shore, have been so thoroughly depopulated that any fishery for scallops there has been abandoned. Occasionally a supply appears at this or that point, but uncertainly and temporarily. I was told, for example, by the oyster-planters on the north shore of Long Island, that scallops were tolerably plentiful there (particularly at Northport) once in five years. Such a statement is puzzling, and leads to a study of the habits of the scallop in search of an explanation.

The proper home of this species (*P. irradians*) seems to be in fairly deep water on a firm bottom—either sand or tough mud; yet in many localities grassy beds (*i. e.*, eel-grass—Zostera) are resorted to by it, especially when young. The general habits and behavior of our American scallops, such as living in companies or "schools," moving about and darting to the surface of the water by a quick opening and shutting of the shells, to sink down again along an inclined plane forward, are familiar to all readers of natural histories, and closely similar to those of the European "St. Jacob's shells."

The spawn of our scallop is thrown out in early summer, and so much of it as becomes fertilized and is able, "catches" or "sets" on stones, sea-weeds and other firm supports, from the sheltered tide-pools down to a considerable depth. By the middle of July this "seed" is about as large as the head of a lead pencil, and it does not drop from its support for two weeks or more. The growth is so very rapid that the young scallops have attained about half their size by the time cold weather checks their advancement.

In November the young scallops, spawned the previous June, will be found in great numbers all along the clean shores of Narragansett bay from an inch to an inch and a half in diameter, and moving about very actively. Where eel-grass grows in great quantities, however, the young keep among it, clinging to the stalks until by their weight they bend them down to the bottom or break them off, and are swept away with the grass when it goes adrift in the fall. Should such a tenanted raft of sea-weed drift into a bay and rest there, as frequently occurs in Long Island sound, that spot will be colonized with scallops, even where none had existed before.

Great numbers, however, forsake the protection of the eel-grass, when old enough, and go "dancing" about the neighborhood till they hit upon the right kind of bottom, when they come to anchor, and stay there unless driven away by extraordinary winter storms. Under such an accident thousands of bushels may sometimes be driven upon the beach, where all are pretty sure to die by freezing. Referring to this point a Sag Harbor man told me that if possible, when driven before a storm, they will work to windward, and he assured me that he had seen them swimming in schools ten feet deep. These movements are all within narrow limits, however, for the restricted bounds of the fishing-grounds are pretty nearly the same from year to year, though often it is impossible to see why the scallops should not extend their range. The young are far more active and swift than the older mollusks. Late in the fall, however, there is reported to be a regular migration of adult scallops toward the shore, whereupon the fishing begins; but this statement is not well substantiated, I fear.

The size of the young scallops is little increased during the colder months, but in the spring a new period of speedy growth begins and maturity is said to be reached within a year. At any rate these mollusks will produce spawn in the June following their birth, and are ready for market the subsequent autumn. The rapidity with which they enlarge their bulk, but more especially their fatness, or proportion of flesh to shell, is remarkable. Thus a bushel of these mollusks will yield only about two quarts of "meats" in October, whereas a bushel from the same locality at Christmas will turn out a gallon.

The fishermen believe that scallops never spawn but once, and die before they reach the age of three years. I am not at all sure this is a fact to the extent alleged, but if so it presents a case where the generations follow one another so closely that there are never two ranks or generations in condition to reproduce at once (except in rare individual instances), since all, or nearly all, of the old ones die before the young become mature enough to spawn. If such a state of affairs exist, of course any catastrophe, such as a destructive winter gale or the freezing over for a long period of the water wherein they lie, by killing all the tender young in a district, will exterminate the breed there, since even if the older ones survive such a shock they would not live long

enough, or at any rate be unable to spawn again, and so fail to start a new generation.

Similarly an unusual attack by natural enemies, or excessive dredging by men, might in one season extirpate the scallops of a whole bed or bay. To its active powers of movement and its migratory habits, the scallop must mainly trust for preservation as a race, and to the fortuitous drifting in of young upon rafts of sea-weed most depleted localities chiefly look for rehabilitation.

Whatever the explanation, the supply has certainly decreased along our coast during the past thirty years, even though at certain points—as in the Peconics—there seems no diminution. The huge, smooth-shelled *Pecten tenuicostatus* of the North, as big as a fruit plate, which formerly abounded on the coast of Maine, has now become so rare as to be a prize in the cabinet of the conchologist rather than an edible commodity—a result unquestionably due to over-greedy catching, and an effective reply to those men who told me that they thought the more the scallop beds were raked the more plentiful the mollusks became. Long Island sound no longer affords profitable fishing, and the depletion there is attributed by the local fishermen to the fact that in culling their dredge-loads the little ones were not thrown back. The same story belongs to New York bay and much of the New Jersey coast. The irregularity in respect to plenitude, and also of the size and fatness of these mollusks in the three localities—Buzzard's bay, Cowesett bay (R. I.) and Long Island—where they are still regularly taken, is steadily complained of.

Scallops are caught by hand-dredging from small sail-boats. The dredges are about thirty inches in width, have a scraper-blade upon the bottom, and in favorable weather several may be thrown over from each boat. In shoal water an iron-framed dip-net is sometimes used on calm days. It is pretty hard work, and entails exposure to very severe weather.

The only edible part of the scallop is the squarish mass of muscle (the adductor) which holds the shells together, and this part is skillfully cut out by "openers," who have their houses at the landing places where the dredgers take their cargoes to be sold. It is the buyer, not the dredger, who "opens" or "cuts out" the meat and prepares it for market. In some places men alone are employed in this work—at others women and girls for the most part, and they will earn from eighty cents to $1.25 a day. The

work is performed with great dexterity. The motions of an expert opener are but three after the scallop is in hand. The bivalve is taken in the left hand, palm up, with the hinges of the scallop toward the opener's body. The knife—a simple piece of steel ground sharp, and with one end stuck in a wooden handle—is inserted in the opening of the shell furthest from the breast. The upper "eye" is severed through by this movement. A flirt at the same moment throws off the upper shell. The second motion cuts the lower fastenings of the eye to the upper shell and takes the soft and useless rim off. The last motion pitches the shell into one barrel and the soft and slimy rim into another, while the eye is thrown into a basin of yellow stoneware holding a gallon. They are then poured from the basin into a large collander, thoroughly washed, placed in clean boxes and shipped to New York and Brooklyn. As little fresh water or ice is placed in contact with the "meats" as possible, as it is thought detrimental to their firmness and flavor. As this is altogether a winter operation, the help of ice in transportation is not usually needed.

There is, or ought to be, no waste in the scallop fishery. On Long Island the refuse is taken by the farmers as manure. These sea-faring agriculturists have always been accustomed to replenish their half-exhausted lands with the scrapings of the beach and with the menhaden and other seine-fish which could be caught plentifully enough for the purpose in the offing—much to the disgust of every stranger who found himself to leeward of their fields. This demand failing, there is always sale for the refuse to the regular fertilizer-factories scattered along the shore.

The shells are preferred above all others by the oyster-planters as "stools" or "cultch" to spread upon their deep-water planting beds as objects upon which the oyster-spawn may "set" and grow. This wise preference is due to the fragility of the scallop-shell, permitting it to break into pieces under the strain of a growing cluster of oysters, each one of which will be benefited by the separation, which frees it from the crowding of its fellows and gives it room to expand by itself into comely and valuable rotundity, instead of remaining a strap-shaped distorted member of a coalescent group. All their shells, therefore, can easily be sold by the openers to the oystermen at from three to five cents a bushel.

The scallop fishery is of small moment in the United States beside the production for market of oysters and clams, and the statistics (for which I am chiefly responsible) are meager, and not later than 1881, though I doubt whether this year's figures would show much difference from the status of five years ago.

Briefly summarized, these show that about 250 men (and for a short season at New Suffolk, Long Island, about 470 women and children, according to Fred. Mather), are engaged in either catching or preparing scallops, using boats and apparatus worth perhaps $20,000.

The total product is from 70,000 to 75,000 gallons of the edible part, as marketed, worth at first hand from $25,000 to $30,000. About one-half of this comes from Peconic bay, and more than half the remainder from Greenwich, Long Island.

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SUPER-METAMORPHISM AND VULCANISM.[1]

BY THEO. B. COMSTOCK.

IF it be true that metamorphism has converted Archæan sedimentary strata into the crystalline condition in which those beds now usually exist, there can be little doubt that some igneous rocks have had a similar origin. We can not detect the direct evidence of such previous condition in the thoroughly fused masses, but there is in many cases no real proof to the contrary, to say the least. Now, if these simple postulates be admitted, how can we consistently deny the possibility—nay, the probability—of the occurrence of all degrees of metamorphism from the simple baking to the melting effects? Geologists have commonly supposed that a well-defined zone of metamorphism has existed over the earth involving just so much of the sub-stratum of the crust, never passing the boundary set by the lowest member of the Palæozoic series. This view does not comport with the very gradual transitions observable in all other natural products, nor can it be reconciled with the numerous facts which go to prove that the great geologic agents of the past are active now as then, in kind if not in degree.

Really, then, it would be marvelous if extended study of geological history should not reveal fluctuations of the metamorphic zone, above and below the arbitrary stratigraphic boundary adopted in the early days of our young science.

[1] Abstract of two papers read before Section E, A. A. A. S., Buffalo, 1885.

Without arguing this point further, I desire to present here some facts which seem to indicate that true Palæozoic strata have in one region (S. W. Colorado) become involved in the zone of metamorphism; that is to say, *super-metamorphism* has occurred. All along the Rocky Mountain chain to the northward the Silurian beds are recognizable, although I have seen them very much baked in portions of Northwestern Wyoming. The same succession of strata from top to bottom of the Palæozoic is discernible southward, as a rule, until we strike the great loop of the continental divide in the San Juan mining region, where the sedimentary formations skirt the base of the Quartzite mountains of Hayden's survey. Here the Carboniferous and the underlying Devonian are well represented, and insignificant remnants of supposed Silurian strata occur *in situ*. In some cases these last-mentioned rocks shade down gradually from the unmodified sediments to the completely metamorphosed layers, and occasionally the Devonian limestone is so intimately connected with the subjacent granite as to form a continuous block of the two rocks *welded* together into one mass. Beneath the granites is a vast formation of quartzite, and the whole section studied by itself and in connection with the succession of strata in the adjoining country, seems to me wholly inexplicable upon any other theory than that of super-metamorphism, involving a considerable thickness of the early Palæozoic beds, including nearly all of the Silurian formation.

This idea, although worked out independently by myself, was, I find, entertained some years ago by Dr. Endlich, who passed rapidly over a part of the region in 1874. The importance of the fact, if such it be, of this super-metamorphism appears very evident when we come to study the history of vulcanism in Colorado and Wyoming. From observations by the writer in the latter area, in 1873, there seems no doubt that very similar conditions have existed in that great focus of eruption, although the results have been there much obscured by the lava flows and less disclosed by subsequent erosion.

Referring to the preceding remarks on super-metamorphism, we may understand how, with a crust offering excessive resistance, the igneous fusion may be longer continued than in the case of a volcanic eruption like those of the early Tertiary in the West or the Hawaiian initial outflows, all of the andesitic type. Von Richthofen's series, as exemplified in the order of succession of

the lavas of the Western United States is, in the rough, of such wide application that we must expect to discover more than a mere accidental cause. The occurrence of only one type of lava, as andesite, trachyte, rhyolite, or basalt, may be readily explained as due to the overcoming of the resistance to outflow at one or other stage of the process of fusion. So, in certain wide areas, it might be possible for all of Richthofen's types to be ejected from as many distinct orographic centers. But in Wyoming and Colorado two great districts have the old volcanic vents so related to each other, in the several flows, that one can not avoid the conclusion that each field has been the seat of one long-continued period of activity marked by successive epochs of eruption. Thirteen years of study in these regions have revealed many facts bearing upon these questions. Having elsewhere outlined a plausible theory of vulcanism,[1] based upon these and general information gleaned from the West Indies in merely traversing that region, together with the published accounts of leading authorities, I shall not here attempt a discussion of it, but confine myself to a simple statement of its main points.

In brief, then, it seems evident that the earliest volcanic outflows came out through lines of least resistance in the axes of folds in the strata. In cases where these lines coincide with the major folds and the lines of maximum tension, the outflow will be andesitic or basaltic, *i. e.*, *basic*. If the tension be not sufficient to overcome the resistance, more acidic material will be formed at the top of the magma, under the folds, and this may burst forth as trachyte, or finally as rhyolite, provided that the resistance is not sooner overcome. Basalt comes last as the deep-seated, heavier portion of the magma, and in some cases this follows andesite without the intervening trachyte and rhyolite.

In the San Juan mining region and in the Yellowstone Park area, the necessary conditions for the successive ejections have been brought about by a somewhat complicated series of foldings, cross-foldings and faults, accompanied by an *elastic* crust of siliceous material. The subject is one which can be studied in these regions to great advantage, but we are only beginning to understand how simple is the problem which nature has solved with much variety of detail to suit changing conditions of environment.

[1] The Geology and Vein-structure of Southwestern Colorado. By Theo. B. Comstock. Transactions Institute of Mining Engineers, Bethlehem meeting, May, 1886 (4 maps). Reprint, pp. 24–29, *et seq.*

ZOIC MAXIMA, OR PERIODS OF NUMERICAL VARIATIONS IN ANIMALS.

BY L. P. GRATACAP.

NO feature, perhaps, in his geological and field study affords the palæontologist more interesting material for his speculations on the conditions of the past, in its zoölogical bearings, than the irregular distribution of organic remains in the fossil-bearing rocks. Not only in the same geological horizon will he find striking variations in the abundance in which the fossils occur, as he passes from layer to layer of contiguous and often of the same beds, but he soon discovers the important fact that localities are distinguished by peculiar fossils, that a limited range circumscribes the lateral as well as the vertical diffusion of a species, as far as regards *numerical concentration*, and that again points or limited areas present, in overflowing numbers, representatives of an organism which, generally occurring throughout a wide geographical range, are at these points illustrated in crowded and exuberant colonies.

The well-known *fish beds*, located by Newberry and Worthen in the Lower Carboniferous limestone of Illinois, are examples of the first case mentioned, the remarkable localization of forms in Wisconsin, instanced by Chamberlain and by him denominated as evidences of "colonial tendencies," is an example of the second, as also to some extent, though these are perhaps in the main instances of a different class of facts, the faunal stations of Williams so admirably depicted in the papers on the "Fossil Faunas of the Upper Devonian,"[1] while the interrupted display of the same species in the same line of outcrop in respect to the relative numbers of specimens to be seen or their local disappearance when the area examined has any considerable extent, corresponding to a beach line of miles in length, illustrates the third class of facts which we refer to, as the diminishment westward from Genesee of Pentamerus in the Clinton rocks of New York.

Associated with these familiar facts is the closely related one of the contrasted size of the same fossil species in different parts of the same formation, a difference of size not always explicable on the mere assumption of favorable or unfavorable environment, of which perhaps the Spergen Hill fossils afford a very pertinent

[1] Bulletin U. S. Geol. Surv., No. 3.

illustration, for, as pointed out by Professor Whitfield,[1] the diminutive fossils of some molluscous species found at Spergen hill became, at Paynter's hill, a little over a mile west of the former locality, much larger, while the Bellerophon and Euomphalus of the Ellettsville, Ind., beds, greatly exceed in size the same species from Spergen hill, and in a less striking way collectors have become familiar with certain localities where certain fossils assume an unusual or handsome size contrasting with their depauperate appearance elsewhere.

A great deal of instructive and careful study has been expended in recent years, since the advance of research has made naturalists better acquainted with the oscillatory character of faunal populations, upon the perplexing question of the contemporaneity and succession of fossil faunas, and Barrande, Etheridge, Hall, Hull and Gosselet abroad, and Williams, Walcott, Call, Clarke and Matthews at home, have pointed out some of the details of their results in this investigation, and have already familiarized the scientific world with the important conception that varietal faunas or modification of a central or controlling animal facies, or even sharply contrasted zoölogical aggregations of species may belong to the same epoch and be laid down in the neighborhood of each other on the same oceanic or lake flooring.

Our intention here was not to discuss the variations of specific forms in the fossil-bearing rocks as throwing light upon the synchronous existence of different faunas, their succession, retreat, reappearance and fusion. It is undoubted that these assumptions explain and are indeed the chief explanations to be offered for the varying character of near-lying fossil groups; but we wish to urge upon the consideration of palæontologists the necessity of allowing—as far as regards the instances of fossil distribution cited above, viz., the greater or less prevalence at near horizons or beds or along the horizontal extension of the same bed of the same fauna or species—for those irregularities of production of life, which cause in our present seas different years to become distinguished for a phenomenal abundance of certain forms, as others to claim a distinction for the abnormal decrease or disappearance of the same forms over the same geographical area. Thus a given spot on a coast line, always yielding a particular species, may in one season become the abode of numbers of these

[1] Bulletin Amer. Mus. Nat. Hist., Vol. I, No. 3.

same animals out of all proportion to its ordinary *census of occupation*, and in another season pass, by an abrupt change or perhaps through a series of less violent alternations, to a condition of comparative or actual denudation of these residents. The work of the Fish Commission has made us familiar with facts of much wider import, when large sections of the oceanic basin have become depopulated. This latter case appears to be catastrophic in its causes, but comes within the scope of our suggestion as to the fluctuating fertility of a species. And the fact becomes sometimes apparent that in a restricted region commanding a more or less fixed supply of nourishment the size of the animals will increase in the years of decreased fertility, and correspondingly diminish in the seasons of enhanced productivity, a relation not unnatural.

To what extent we may parallelize these two classes of facts, the one dealing with the changing abundance of fossil shells or remains, either vertically or horizontally distributed in beds of the same age, and the other exhibiting the varying numbers, in separated seasons, of contemporaneous animals along our seaboards, or in our fresh-water lakes, or even, so far as we can determine, in the pelagic areas, is not at first, or in all cases equally easy to determine. But it is possible to review some considerations bearing upon the general question.

The observations which may be adduced as bearing on this question are necessarily widely scattered, and when found are for the most part concerned with those forms of life which subserve some industrial or economic uses, or with those in close relation with the former, as, for instance, the recorded irruptions of starfishes (*Asterias forbesii*) and "drills" (*Urosalpinx cinerea*) in different years upon our oyster beds. In classifying, however, the efficient causes which effect these variations of animal populousness, without entrenching upon ground more or less speculative, we may say that the changing abundance of animal forms in different years or localities arises mainly from:

1st. Opportunity for or difficulty in obtaining fecundation.

2d. Constitution, rate of growth, habits, etc., of organism.

3d. Character of habitat in relation to bottom.

4th. Phenomenal influences, as cataclysms, poisoned or heated waters, storms, destruction by enemies.

1. Opportunity for or difficulty in obtaining fecundation.—That

this has an important influence in securing a great or small representation of the marine animals in modern seas is unquestioned, though it is always, of course, a variable function of the more or less rapid and safe methods nature uses for their multiplication. Dr. Brooks says:[1] "The most critical time in the life of the American oyster is undoubtedly the time when the egg is discharged into the water to be fertilized, for the chance that each egg which floats out into the ocean to shift for itself will immediately meet with a male cell, is very slight, and it is essential that the egg should be fertilized very quickly, for the unfertilized egg is destroyed by the sea water in a very short time."

Tryon has suggested that the swimming species of Cephalopoda may experience some difficulty in effecting sexual union,[2] and the observations of Steenstrup upon the many different ways adopted in this group of Mollusca for fertilization, justify the inference that under unfavorable circumstances individuals of the same group may not encounter each other, and the chances for the fruitage of the same genera be diminished in exact ratio to the opposite plan pursued by its congeners for their fecundation. With some of the gastropods sexual union is effected directly, and no danger is incurred from the exigencies of the unprotected female ovum searching for the spermatic vesicles in the water. This establishes a safeguard which favors the multiplication of those prosobranchiates which possess it, but in other groups (Trochus, Scutibranchs, Cyclobranchs) the male elements are discharged into the water, and are then taken into the uterus. This introduces a risk which must increase or lessen according to the presence or absence of predatory fishes who devour the spat, the favorable stillness of the water or its temperature, or chemical condition, which if abnormal would destroy the germs.

Professor Morse[3] has described the difficulty, arising at a rocky point at Eastport, Maine, of the larger males of *Buccinum undatum* securing contact with the diminutive females secreted in the narrow apertures and crevices of the ledge, a state of things which at first would have a tendency to reduce the number of the individuals until a sufficient number of small males were evolved

[1] Bull. U. S. National Mus., No. 27, p. 210.
[2] Manual of Conchology, Vol. I, p. 42.
[3] Proc. Boston Soc. Nat. Hist., Vol. XVIII, p. 284.

to maintain the most complete generative activity, though this very contraction of size might diminish vitality, disarrange the seminal function and result in sterility.

The orders of Cladocera, Copepoda and Ostracoda will, in this respect, be favorably placed in comparison with other crustacean groups, as in these tribes fertilization of the female lasts during her lifetime, or at least a season, and in some cases the young females are born fertilized from the impregnated mother. Thus favorable conditions with these groups gain a predominating influence, as they fortify and assist an already preëxistent advantageous arrangement for security of fecundation.

Amongst fishes advantage will be given to those whose spawning season is most extended, as with cod, with which, according to the observations of Professor Sars, it extends over nine consecutive months, "a period exceeding that required by any other species of which we have any knowledge."[1] These are not only more likely, with equal vitality, to produce a larger number of individuals, but they are absolutely favored, by the greater extension of time, to escape variable inimical circumstances, which latter, being limited in duration, might, if coincident with the shorter period of other fishes, greatly impair the prospects of successful fecundation. The longer period of the cod renders its partial or entire escape from such disasters more probable. The spawning season for an individual of shad, salmon, or white fish is only a few days. But the likelihood of impregnation seems to be diminished on spawning grounds where strong currents are found, or during storms, as immense numbers of the eggs are driven on the shores, or are so diffused and distributed as not to meet the milt of the male, and as the egg of the cod quickly loses its vitality, great numbers perish. Under very favorable circumstances such conditions for impregnation might prevail as would result in an enormous excess of individuals produced, whilst an opposite state of affairs would reduce the production to a minimum. Again, an insufficient supply of males would greatly modify the results of fecundation, as the extraordinary fertility in eggs of the female amongst fish necessitates the presence of several males to accomplish their fertilization. Eggs of fish which are of such a gravity as not to rise to the surface, unlike those of the cod and mackerel, come less in contact with the destructive

[1] Bull. U. S. Fish Commission, Part v.

agencies of the surface, and increase their likelihood of fecundation by the longer possible period thus secured for a greater number.

Such fish as spawn in rivers or in the later seasons, as early summer, may be in some instances, or most, more likely to perpetuate a greater number of offspring than their congeners whose eggs in the ocean are exposed to greater risks of destruction or at seasons when storms are prevalent, though this consideration is again modified by the possible presence in either case of more numerous enemies.

II. Constitution, rate of growth, habits, etc., of an organism.— It is obvious that conditions favorable for the preservation and maturization of individuals will prevail when these conditions harmonize with the habit and life-history of the organism, and that the reverse will ensue when they do not, and other things being equal we may expect those species to predominate at a locality whose habits, life-history, etc., are either best adapted to the conditions of that locality over its competitors, or are of such a character as to withstand conditions which, generally unfavorable to all forms of life, are met by it with better safeguards and greater resistance.

Under unfavorable conditions the longer time in which the young of a marine shell are free before attachment, the less chance for a survival of a great number, and at such a time a selection would be effected in favor of those species whose spat most quickly came to rest, and these would subsequently become phenomenally frequent.

Again, the power of an organism to endure change of temperature, as compared with others less able to survive variation in this respect, obviously works in its favor, and may lead to an *apparent* excess of individuals. As Semper says,[1] "a small fall in temperature may be as injurious to one animal as a great fall to another, while a third species may be wholly unaffected by either." Möbius has designated animals under this regard as *eurythermal* and *stenothermal*, as they are qualified to endure great or small variations of temperature. This will also have an important influence on size, as Möbius has shown that the same species of mollusk living on the coast of Greenland or in the Baltic was in the former case large, in the latter dwarfed, and he at-

[1] Animal Life, p. 105.

tributed it to the variable temperature in the latter locality. Rate of growth as it is rapid or slow, continuous or periodic, will affect the numerical display of a species. Thus *Pecten irradians* grows very quickly, stops in winter, beginning again when the scallops are one year old, and on the whole this irregularity may be regarded as tending to diminish numbers. Power of locomotion again assists its possessors to escape from unfavorable surroundings or from enemies. Swarming or migratory habits, as with lobsters, affect the numerical proportion of the species at a given point in certain seasons, but probably has little influence on the fertility or abundance of individuals. Those animals, as crustaceans, which cast their integuments, are exposed to accidents during their exposed period, and should they then be subjected to especially destructive influences would suffer great numerical depletion.

III. Character of habitat in relation to bottom, temperature, depth, isolation, salinity and supply of food.—The overwhelming importance of these very variable factors upon the numerical exhibit of a species is most evident, and has, from many points of view, been emphasized by naturalists. Thus the nature of the bottom exercises a predisposing selective influence upon molluscous distribution. It is well known that oysters are killed in the mud, that the round clam affects sandy and muddy shores, the edible muscle flourishes in a variety of positions and surroundings, that the Purpura loves rocky headlands, and so on indefinitely. The temperature of the water exercises an accelerating or retarding influence upon the growth and spawning of both shells and crustaceans according to their nature in this respect, and the increase or decrease of heat. In the matter of living at different depths, animals vary extremely, and the sudden settling of a shore or even rapid secular change would tend to destroy the classes of shallow-water loving organisms. Isolation permits close interbreeding, subjects the species to more uniform conditions, and if it diminishes the volume of water seriously modifies the size, as shown with Lymnæa by Semper and Hilger, while of course it induces peculiarities of local development. Salinity varies in sea water and enclosed areas of the ocean, and distinctly modifies the abundance of animal life. The character of the supply of food and its abundance is an obvious element of great importance in the production of sea animals.

IV. Phenomenal influences, as cataclysms, poisoned or heated waters, storms, shocks, destruction by enemies.—It is enough to mention these to suggest their frequent occurrence. But the effect of these in geological time has been, doubtless in some case, to produce deposits of animal forms in sudden abundance, as when a fauna by their action has almost simultaneously disappeared. Thus Dr. Newberry has suggested that the fish beds of Illinois afford evidence of a wholesale destruction of fish life, possibly through submarine explosion, diffusion of poisoned vapors, etc., while the phenomenal disappearance of animal life from the Atlantic, as shown by the observations of the Fish Commission in 1881, is a modern instance of a widely extended catastrophic obliteration of animal forms.

Zoic Maxima.—It is evident that if all the above conditions were favorably conjoined for some reasons, in accordance with the needs of any special organism or any group of organisms, that these would attain probably an unusual fertility, and that if passing such a climax as this the succeeding years would develop conditions in the same way, as strikingly unfavorable, we would have in the marine deposits, accumulated during these years, two contrasted beds of respectively rich and barren contents connected or graded into each other by intervening beds of diminishing productivity in shell remains. But if after a period of phenomenal activity and success in the production of forms such as instanced, a disaster, such as those we have suggested under the fourth heading, took place, then we would have a bed gradually reached through lower beds of increasing numerical strength until it crowned the series as a climacteric to be succeeded by later layers quite devoid of animal remains.

These periods, when all the conditions are most favorable for animal multiplication, we designate as Zoic Maxima; and as they are in accordance with the requirements of the greatest number of specific forms we call them Pan-zoic Maxima; or as they are so combined as to exert a selective influence, permitting the preponderance of one or a few species, or directly contributing to the propagation of this one species both in numbers and in size, we call them Sol-zoic Maxima.

It is certainly true and known that such Zoic Maxima, both in their general and restricted manifestations, are known in our contemporaneous faunas. It is probable that the varying abundance of fossil remains in the beds of fossil-bearing rocks are due to similar causes.

THE PEABODY MUSEUM'S EXPLORATIONS IN OHIO.

BY F. W. PUTNAM.

I CAN truly say a new chapter has been added to our archæological work in the valley of the Little Miami. First, you must know that our camp is pitched by the side of the great pile of earth we turned over in our explorations of the group of altar mounds on the land of Mr. Michael Turner. We have been working, with occasional necessary intermissions, on this and the adjoining farm of Mr. Benjamin Marriott for the past five years, and this is the place where we have discovered so much of interest within the great earthwork of which the following is a sketch:

A hill through which two ditches, thirty feet deep, had been cut, separated the hill into three parts. Around the central portion a wall of earth had been raised, making a perfect circle 550 feet in diameter. In this inclosure was a large mound, and near it a small one. These mounds proved of great interest, particularly the large one, with its stone wall four feet high, surrounding an altar of burnt clay. We found several human skeletons in the clay outside of the stone wall and two others on the wall, with various objects made of copper, shell and stone. The earth taken from the ditches was used to make the graded way from the top of the hill to the level land below. This graded way connects with an embankment of earth, somewhat oval in shape and 1500 feet in its greatest diameter, in which are two openings. Opposite the northern opening is an earth circle 300 feet in diameter, and in this is a small mound which we have not yet explored. Opposite the eastern opening is a mound nine feet high. It was on this mound that we began our work at this place five years ago. At the foot of the graded way is a small circle inclosing a burial mound. North of this circle were two other burial mounds, and east of it was the great group of altar mounds, around each of which was a wall of stones four feet high, built below the surrounding level of the field. These mounds contained from one to seven altars, formed of clay, on which fierce fires had been made. It was in two of the basins of the altars in the mounds that I found the immense number of ornaments of various kinds, particularly of copper, the 60,000 pearls, shell-beads and other objects, also the wonderful little figures of terra

cotta representing men and women. All these objects had been thrown into the fires upon the altars, evidently as sacrifices or burnt offerings during an important ceremony. The thirty-seven pits with the singular tubes or "flues" connected with them; the concrete layer of gravel and iron over them; the singular structure of the great mound, a hundred feet in diameter and twenty feet high; the great pit containing the many skulls, some of which had holes drilled in them, arranged around two skeletons placed in ashes, all serve to show that connected with this group of mounds were extensive ceremonies of the deepest import to the people.

These extensive earthworks, made on such an elaborate scale, and containing evidence of the wealth of the builders as well as of the ceremonial character of the works themselves, necessarily lead to the conclusion that there must have been a large number of people connected with their construction. The beautiful location of this group of earthworks on the level second terrace which extends for miles in the fertile valley, and is surrounded by hills from which flow never-failing springs, indicate that in this region there must have been a large population; yet the few human remains which we found in the mounds within and without the encircling wall are not sufficient to meet the requirements. Such remains were probably those of distinguished persons, buried with special honors; but where were the other dead? Then the many altars, or basins of burned clay, which evidently had been used over and over again, and were, with two exceptions, empty when the mounds were erected over them, are indications of cremation, and yet where were the burnt human remains? Cremation in open fires will, necessarily, leave many fragments of calcined bones with the ashes, unless such remains are burnt over and over again, and special pains taken to reduce all to ashes, and yet we had found, in a niche of the stone wall about the large altar mound, the burnt bones and ashes of but one individual. If these altars were the places where cremation took place, what then had become of the remains? These were questions which Dr. Metz and myself often asked of each other, and we felt confident that somewhere near by there must be a general burial place for the common dead, and many a hunt was made for surface indications. On the north and south sides of Mr. Turner's barn, and west of the large circle, are two scarcely

perceptible ridges, similar to other slight irregularities here and there over the field. Owing to the cultivating of this place for many years and to the tramping of cattle in the barnyard, these ridges have been more or less worn down, and a few water-worn stones have been exposed on the surface. These were first noticed by Dr. Metz about a year ago. As soon as our camp was pitched we took a look at these water-worn stones. They were fragments of limestone filled with fossils of the Silurian age lying on a deposit of gravel over which, long ago, had flowed the waters of the Little Miami. What more could these stones have said, had they been endowed with speech, than that which was evident to our eyes: "We were long ago brought here by men." Here, then, was something more to be revealed in connection with the history of these great earthworks of an ancient race, and here we would dig a trench on the morrow. We started our trench sixty feet west from the wall of the circle, and well outside of the slightly elevated portion, which, we were afterward told by Mr. Snyder who remembers the place fifty years ago, was formerly much more marked, and had the appearance of a long low mound. Digging down to the hard pan, we carried our trench westward for about ten feet, when we came to three large water-worn stones regularly arranged, side by side, in the gravel hard pan.

It is necessary to fully understand the character of the earth in which we were working in order to appreciate the labors of the ancient people at this place, and I may well add our own in making these researches. First, the surface consists of a few inches of dark soil overlying from eight to ten inches of clay. Under this clay is a layer of coarse gravel containing many pebbles, some of considerable size, but all colored and firmly cemented by an amount of iron which, from some natural cause, is far in excess of that in the gravel all about. This iron-cemented gravel forms an irregular layer of from one to four feet in depth, and under it is a loose, uncolored gravel mixed with sand which, judging from a pit near by, is certainly thirty feet in depth, and probably much more. It may be that this is part of the great terminal glacial moraine which Professor Wright has been tracing across the State of Ohio. In this iron gravel the stones we found were imbedded. On cleaning off these stones we found that there were others at right angles to them, and soon we made out

that we had at last discovered a grave. Would it prove to have any connection with the people who built the earthworks and the altar mounds? Our hopes were great, and they were soon to be realized as far as one grave could tell its story. On carefully removing the earth from the eastern end of the grave, close to the stone, we discovered the toe bones of a human skeleton, and after several hours of the hardest kind of trowel digging, we had the satisfaction of exposing the skeleton lying at full length on its back. Its skull, slightly turned to the right, rested on a flat stone at the western end of the grave. On the left side of the skull was a large sea-shell of the genus Busycon, from which the central portion had been removed, a common method of making vessels among the various peoples of America, and often found in burial mounds and graves from the Gulf States to Michigan. With the bones of the neck were several shell beads, also of a common form, and as widely distributed over the country as the Busycon shells. The arms were extended at full length along each side, and inclosed by the bones of each hand, resting on the hips was a spool-shaped ornament (which our explorations have proved to be ear ornaments) made of copper, and like those found with several of the skeletons in the mounds of this group. We have at the museum ear ornaments of this character from burial mounds in various parts of Ohio and west to the Mississippi in Illinois, and from Central Tennessee, but I have never found them in any of the several thousand stone graves of the Cumberland valley which I have explored, nor have we found a trace of them among the several thousand graves associated with the singular ash-pits in the cemeteries which we have explored in the Little Miami valley, nor with the skeletons buried in the stone mounds nor in many of the simple burial mounds of Ohio. They seem to be particularly associated with the remains of a people who practiced cremation to some extent, and who built many of the great earthworks of the Ohio valley. That it is an ancient form of ornament, made from native copper, there can be no doubt, although they may have been made also by the descendants or conquerors of this people in later times; and it is not at all improbable that the form of the ornament may have survived to the time of contact of the "red race" with the white. I can only say that in all the recent Indian graves I have opened, or know about, this peculiar character of ornament has not been

found; and if they were ever made by the whites and furnished to the Indians, I have never happened to find any that showed evidence of the fact. We have certainly found them under such conditions in Ohio that they must have been buried with their owners long before the discovery of America. Then again, all we have found have been made by hammering pieces of native copper, and not by casting the metal.

By the side of the right tibia of the skeleton in the grave was a copper pin, a wooden bead covered with thin copper, a few long, slender flakes of flint, and a fragment of some kind of an ornament made of shell. These long flint knives are of the same shape and character as the well known obsidian flakes from Mexico, and we have found them, as a rule, associated with copper ear ornaments like those in this grave. They are sharp edged, and are as good knives as the Mexican flakes. While speaking of them in general terms as flint, they are in reality flakes struck from several varieties of stones, many of them being of a bright red jasper and others of chalcedony. The wooden bead covered with copper is of the same character as others we have taken from the burial mounds in which we have found the copper ear ornaments. Close to the right hand and hip, but two inches above them, and covering a space a foot in diameter, were a mass of fragments of burnt human bones, with bits of charcoal mixed with ashes. These remains of a cremated body had been gathered from the place where it had been burnt, brought to this grave and placed by the side of the body at the time it was laid in the grave. The close contact of the remains to the finger bones of the skeleton, which were not disturbed, was sufficient evidence of this. Here, then, in one grave, we had found the evidence associating it with the altar mounds and the rest of the earthworks about, independently of the fact that the grave itself was within the earth wall surrounding all the other works. We had found evidently the burial place of the people, and this was abundantly confirmed as our work progressed.

We have now for two weeks been engaged in exploring this burial place, and during this time we have discovered eighteen graves, four large deep pits, and several holes dug in the gravel, as well as places where there had been fires, and numerous other interesting facts, many of which by themselves would be trivial, but which, when they are all put together, will give a far better

idea of the customs and works of the people who made the great earthworks in Ohio than it has been possible heretofore to obtain. All other explorations in the State have been fragmentary. No other systematic work has been attempted, and hence we have had plenty of theories built upon partial facts. We have much to do before the exploration is completed even of this single group.

To give a detailed account of all we have found during these two weeks would, I fear, draw too much on the patience, and I shall only call attention now to a few of the more interesting points. Individuality had its exemplification in this old cemetery, the same as it has in our modern ones, and the modifications are so great that no two of the graves thus far discovered are alike. In one instance there were no stones about the skeleton; in another a carefully built wall had been made of long, narrow, flat stones, and a regular wall, four layers high, had been made in the same way that a mason lays bricks, but without mortar. In some graves flat stones were placed at the bottom; in others the skeleton was firmly imbedded in the gravel, while in one the body had been placed on a thin layer of clay placed over the gravel. In one grave there were two skeletons, one extended at full length on its back and the other crowded into the grave by the side of the right leg of the first. A child was placed in a small circular grave, the body having been so arranged that the head and the feet were not far apart. Most of the graves were comparatively shallow, extending from six inches to a foot into the layer of gravel. The deeper the grave the better the condition of the skeleton. One grave was dug to the depth of nearly four feet in the gravel, and was seven feet long by four in width. At the bottom was a pavement of flat stones, fourty-nine in number. On these stones the body had been extended, and the grave had been filled up with over three hundred stones, all of which had been brought from the river bed, nearly a quarter of a mile distant. Over these stones six inches of gravel had been placed, around and over which other stones had been regularly arranged. The free percolation of water through the stones had filled up the grave and caused the skeleton to decay, only a few fragments being left. The graves were not covered with large stones, as is the case with the stone graves of Tennessee, and there is but little in common between the two. Another class of graves were

basin-shaped, small in size, and carefully made of flat stones. In them we found burnt human bones and ashes. In one was a pipe carved from stone which had been burnt with the body, and in another were fragments of a burnt copper ornament.

I must give an account of the graves which were of particular interest.

Grave No. 5 in our notebook was six feet six inches long, two feet nine inches wide, and one foot eight inches deep, measured from top of the stones. It was made with care, and the stones were carefully placed so as to form a substantial wall. The bottom was completely covered by four large, flat stones, on which the skeleton lay on its back. The skull was at the east end of the grave. When the body was put in the grave the knees were drawn up, the left hand rested on the body, and the right was laid straight along the side. The result was that the bones of the left hand were found in close contact with the upper ends of the tibiæ, which had fallen down between the femora. In the bones of each hand was a copper ear ornament like those I have mentioned. In the corner of the grave, near the bones of the left foot, was a large sea shell, from which the central portion had been cut away. Near this was a little cup carved out of stone, two canine teeth of a bear, each with lateral perforations, and in each tooth was the chalky remnant of a large pearl. Close to them was a large crystal of galena, and a knife made of a long flake of flint. On the same side of the grave, nearly opposite to the shoulder and partly under the side stones, were eight of the copper ear ornaments in a bunch, and under them a long bone point. We did not discover them until we had taken out the skeleton and began to remove the stones, for it is our rule always to remove everything placed by human hands, and to turn over every inch of dirt previously disturbed. On taking up the flat stones, which were firmly imbedded in the gravel, and had their edges covered by the side stones, we found the following articles, which must have been placed where we found them before the stones had been put down. Under the second stone (there was nothing under the first) near the center was a copper bead and small thin pieces of iron, probably meteoric, but it has not yet been analyzed, and it may prove to be bog iron which has formed in that place. As we have found several ornaments made of meteoric iron on the altars of the mounds in this group, as well as two good-sized

pieces of an iron meteorite, I strongly suspect that this iron will prove to be the same. Under the third stone, were two disks or halves of a copper ear ornament. These were several inches apart, and must have been so placed when the stone was put down. Near these was a wooden bead, with a thin covering of copper. Under the next, or fourth stone, were several of the long flint flakes or knives, and eight inches from the edge of the stone was a small copper celt. · These deposits, under the stones of which the body was to be placed, certainly suggest the offerings of friends at the time the grave was prepared, and the various other objects placed in the grave with the body can, with equal reason, be looked upon as the property of the deceased, or as friendly offerings. At all events they are important as proof that the individuals buried here belonged to the people who built the mounds, as these several objects are of the same character as the many we have found on the altars, and with the few skeletons in the burial mounds of the group.

Grave 15 of our notes was remarkable for the care with which the walls, sixteen inches high at the head and foot, were made of four layers of flat stones, while along the sides, in the clay above the gravel layer, were simply a row of stones. The skeleton was lying firmly imbedded in the gravel, extended at full length on its back, with the skull at the west end of the grave, while the toe bones were against the opposite stones. The skeleton thus extended the full length of the grave, which was six feet three inches. As with nearly all the adult skeletons, there was a copper ear ornament in the bones of each hand. On the breast bone was a copper band. At the neck were two shell beads, and near the left shoulder was a flake knife. A few inches from the left foot were about twenty of the long flake knives, carefully laid together, as if they had been wrapped in a piece of skin or cloth when placed in the grave.

With two other skeletons we found celts made of soft coal. These were perfectly made, with fine smooth edges and polished surfaces, in exact imitation of the ordinary stone celt or hatchet; but as they would have been worthless for the uses to which stone celts were put, it is likely that they were ornamental or ceremonial objects.

I will allude only to one more grave, No. 18 of our notes. This was marked by a mass of gravel a little over seven feet long and

nearly three feet in width, around the edges of which were small stones, eight to twelve inches long. This mass stood up eight inches from the gravel layer under the clay. Removing these stones and gravel, we found loose gravel filling a pit just seven feet long and three feet four inches wide. At the depth of two feet we came to hard undisturbed gravel, and on this was a human skeleton extended at full length on its back, with the skull at the south-east end of the grave. The bones were firmly imbedded in the gravel, and so dry that great care was necessary in removing this matrix. However, after six hours of unremitted labor with small trowel and brush, they and the several objects associated with them were all uncovered and left in place, even to the finger and toe bones, and a photograph was taken showing everything in place. In each hand was one of the copper ear ornaments of the kind I have referred to so often. The finger bones were so arranged as to show that these ornaments had been clasped in the hands at the time of the burial of the body. Another of these ornaments was on the neck bones in contact with the under jaw. On each side of the copper ornament was a canine tooth of a bear, with the lateral perforations. Partly over the bear's tooth, on the left side, was a piece of native copper, which had been hammered roughly into a flat, thick, irregular sheet. This is without holes, and is probably an unfinished ornament. Above this, and close to the skull, was a small copper cone, like many found on the altar of the great mound. Near the right shoulder was a large sea shell, like the others I have mentioned. This skeleton, as it lay in the grave, measured five feet ten inches from the top of the skull to the tip of the great toe, and the individual was not far from five feet four inches in height when living. With the exception of a portion of the sacrum, which had entirely disappeared, this skeleton was taken out in a perfect condition. The decay of the sacrum was owing, probably, to the fact that a small round stone had fallen in such a way as to allow water to percolate around it.

This skeleton is a good illustration of the absurdity of the common notion that as soon as skeletons which have long been buried are exposed to the air they fall to dust. I always have a quiet laugh when I read notices of that kind, and you may put all such accounts down to the inexperienced and clumsy work of the person removing the skeleton. The fact is that it requires

great care to remove the earth from about the bones, and very few persons will take the time to do it properly. As soon as a bone is uncovered most persons attempt to remove it at once, and of course it goes to pieces. Now if a skeleton is in dry earth or gravel, and is very dry and crumbling, the proper mode of procedure is to uncover the bones with great care, loosening the earth with the point of a small flat trowel and removing it from the bones by means of a small broom, or clothes brush, then let the moist air come in contact with the bone, or, if the air is very dry and hot, sprinkle the bones with water and let them absorb all they will. In this way the particles of bone swell and interlock, and after a while the bone can be safely taken up by avoiding force in removing it from the earth. In case the bones are in wet clay or earth the matrix must be removed with great care. In such cases the bones are soft and spongy and they must be allowed to remain in place until they have dried off; but they must not be exposed to the full heat of the sun, otherwise they will crack and splinter as they dry. Of course instances often occur where we find only minute fragments of a skeleton in a grave, all the rest having passed through a chemical change and been reduced to its earthly particles; but that every bone found in a grave can be preserved by using proper care I know from long experience to be the case. I may also call attention to the fact that the state of perfection of the skeleton, outside of certain limits, is not evidence, by itself, of the antiquity of the bones, as the conditions of burial, as well as the character of the bones must be taken into account.

In our exploration of this burial place we found three large pits which were covered with gravel and stones, like the grave I have just described. These pits had been dug through the compact iron-cemented gravel below the clay, even to the depth of five feet, and all the material taken from them had been carried away. The pits were then filled with ashes and burned earth, and covered with several inches of gravel and stones, like a grave. The sides of the pit were not burned, so it is evident that the ashes were not from fires on the spot. There were several places uncovered by our excavations near these pits or graves where fires had been made on the clay or gravel, but the ashes had been removed, and hence it is probable that they had been put in these carefully marked pits. But what had become of the gravel taken from them?

It is to be remembered that in the great mound of the group of altar mounds there was a layer of gravel two or three inches thick, which we have called the concrete layer. This gravel was cemented by a large amount of iron, and it has been a puzzle where the iron came from. It was far too great in amount to have been derived from the clay in the mound above, and besides, the gravel of the same layer, about the edges, was loose and light without any mixture of iron. Now this iron gravel from the burial place is of the same character as that forming the concrete layer in the mound, and it therefore seems probable that these pits must have been dug for the purpose of obtaining it. As this gravel had been used during the extensive ceremonies which must have taken place at the time the mound was constructed, the very place from which it was taken seems to have been held sacred and the pits therefore filled with burnt material, covered over and marked in the same manner as some of the graves. This again is further evidence of the connection of the burial place and the ceremonies which took place there with the altar mounds. The more we examine into the details of this wonderful group of ancient works, the more interesting and instructive they become. We have already spread before us the outlines of a grand picture of the singular ceremonies connected with the religious and mortuary customs of a strange people. There are still some touches to be given before the picture is complete, but it is more perfect than any other that has been drawn, and as our work goes on we may yet be able to fill it out, and finally present it as a perfect whole.—*The Boston Herald.*

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AN INTERESTING CONNECTING GENUS OF CHORDATA.

BY E. D. COPE.

IT is well known that the only orifice in the cranial parts of the carapace in those so-called fishes of the Old Red sandstone, Pterichthys and Bothriolepis, is single and median, and is transversely placed, so as to cover the space occupied by the orbits and the interorbital region in such Vertebrata as have the eyes superior and close together. In the genus Cephalaspis, which has been also supposed to be a fish, two orbits and an interspace occupy about the corresponding position in the cranial buckler.

There is found, lying in the median orifice of Bothriolepis, a bony valve, which is quite free all round. This has been supposed to represent the interorbital part of the carapace, and the uncovered parts of the orifice, at each of its extremities, have been supposed to be the orbits. An examination of numerous specimens of *Bothriolepis canadensis* Whiteaves, has lead me to oppose this latter view. I have, on the contrary, considered the entire orifice to be probably homologous with the "nasal pouch" of the lampreys, and the mouth of the Tunicata and of the invertebrates.[1] This character, together with the absence of lower jaw, would refer the genus to the Marsipobranchii or class of lampreys, or to the Tunicata. From its considerable resemblance in the carapace to the tunicate Chelysoma, and in the lateral arms, to Appendicularia, I referred Bothriolepis provisionally to that class.

The Cephalaspididæ are more like fishes than the Pterichthyidæ, in that they have a distinct head and distinct orbits. They have, however, no lower jaw, and thus approach, if they do not enter, the Marsipobranchii. But they have no nasal pouch or nostrils, as has been observed by Dr. Lankester. This character separates them widely from either fishes or Marsipobranchii. It also gives color to the supposition that the orbits in this family represent the extremities of the median orifice of Bothriolepis.

A highly interesting specimen, which I owe to the kindness of my friend, R. D. Lacoe, of Pittston, Pennsylvania, throws considerable light on this subject. It consists of the cast of the cranial and nuchal buckler of a vertebrate allied to, but different from, the families above mentioned. The fact that it is derived from a higher geological horizon than any of them, that is, from the coal measures, adds to its interest. Besides the typical specimen other portions of a probable body-buckler are in my possession.

The characteristic peculiarity of this form consists in the fact that it combines the presence of orbits similar to those of Cephalaspis, with a median orifice between them, in the position of that of Bothriolepis. And this median orifice is divided into two equal parts by a narrow longitudinal septum. The parts are well preserved in the specimen, and perfectly distinct. The two median orifices perforate the middle of the region which is occupied

[1] AMERICAN NATURALIST, 1885, p. 289.

by the plate of Bothriolepis, but differing from it in being continuous anteriorly and posteriorly with the rest of the buckler.

This structure makes it probable that the median orifice of the Pterichthyidæ represents both protostome (nares) and orbits, and that these orifices have become differentiated in later forms. The protostome in Bothriolepis is covered by a probably movable valve. That the organ of smell should have been differentiated from a primitive mouth is altogether reasonable in view of the close relationship subsisting between these senses; but that the sense of sight should have had a common orifice is not to be anticipated. The recent remarkable discovery of a rudimental eye in the pineal gland of lizards does not throw much light on the subject, since true eyes coëxist with it in those animals, and the median eyes of the Pterichthyidæ had left the field long before the advent of Reptilia, in a phylogenetic sense. From a chronological point of view it is not unlikely that the present new genus brings such forms closer together, since there is little doubt but that the Pelycosauria of the Permian possessed large pineal eyes.

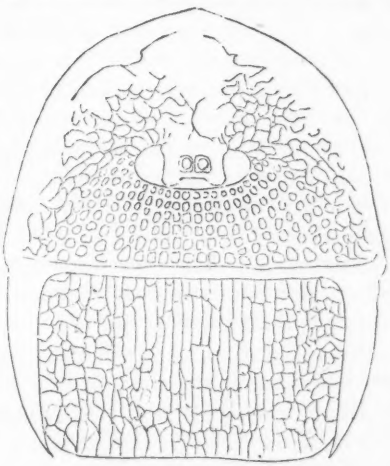

FIG. 1.—*Mycterops ordinatus* Cope. Cranial and nuchal buckler from above, ¼ natural size.

The new genus here referred to may be named Mycterops, and the single species which thus far represents it may be called *Mycterops ordinatus*. The generic character is as follows:

Cranial buckler undivided, terminating in an acute spine-like process at each postero-external angle, which is directed backwards, and without articulations. The space between these spines, occupied by a large undivided shield, separated by a transverse suture from the cranial buckler.

The species characters are as follows:

Muzzle broadly rounded. Orbits semicircular or widely cres-

centic, the flat or concave border inwards; the long diameter anteroposterior. Nares close together, each with a subquadrate outline, and separated from the orbit by a space a little greater than its own diameter. Their borders are slightly elevated, especially above a shallow groove that connects the orbits behind them. Nuchal plate twice as wide as long, its posterior outline a little convex, its posterior external angle reached by the acute apex of the cephalic spine. The median anterior border of the cephalic buckler is damaged so as not to give its exact outline, but the muzzle was probably broadly rounded. The lateral borders are nearly straight, and they diverge to near the base of the spine. The external border of the latter is gently convex, and turns inwards posteriorly. The surface is marked by longitudinal lines of flat tubercles, or raised areas, which are separated by narrow grooves, and have various lengths. Those on the head are usually as wide as long, while those on the nape are generally much longer than wide. Those near the borders are always broken up, and those at the side and in front of the orbits are irregularly distributed. Cephalic border and spine smooth. The size varies. The type specimen has the head as large as a fully-grown *Amiurus catus*, but parts of others indicate individuals approaching double that size.

Returning to the presentation of the systematic relations of this form, it may be observed that in spite of its resemblances to the Pterichthyidæ and the Cephalaspididæ, it must be distinctly separated from both families. Supposing it to possess a ventral plastron like that of the former and Coccosteus, which is probable, we must not attach too much importance to the fact. It was on the presence of the carapace and plastron of these forms that Owen established his order of Placoganoids. But this character constitutes no greater bond than the possession of scales by many fishes; and equally heterogeneous elements are embraced in Professor Owen's division. Thus Coccosteus and Dinichthys have well-developed cranium with distinct mandibular and scapular arch. None of the elements of a cranium are distinguishable in the Pterichthyidæ and Cephalaspidæ, and neither of them possesses a lower jaw or scapular arch.[1] Mycterops must be associated with the latter. But it differs from both in the characters of its orbits and nares, and

[1] A pectoral limb has been observed in Cephalaspis, but no scapular arch.

must be kept well apart from them on this account. The relations of all these forms to known types may be tentatively represented in the following scheme:

Class TUNICATA.

Order ANTIARCHA. Vent posterior; ? mouth as well as protostome present.

Fam. *Bothriolepididæ.* Caudal region absorbed.

Fam. *Pterichthyidæ.* Caudal region present.

Class AGNATHA. Without lower jaw or scapular arch.

Subclass ARRHINA. No nares.

Fam. *Cephalaspididæ.*

Subclass MONORRHINA (Marsipobranchii). A single median nareal orifice.

Order HYPEROARTI (Myxinidæ).

Order HYPEROTRETI (Petromyzontidæ).

Subclass DIPLORRHINA. Two median nareal orifices.

Fam. *Mycteropidæ.* Cephalic and ventral bucklers.

Class PISCES.

Subclass 1. HOLOCEPHALI.

" 2. DIPNOI.

" 3. SELACHII,

" 4. TELEOSTOMI.

Order PLACOGANOIDEI. The structure of the fins of this order being unknown it cannot be referred to either of the three primary divisions (Crossopterygia, Chrondostei and Actinopteri) with certainty. Supposing it to belong to the last named, it agrees best with the Isospondyli, but apparently differs in the lack of some of the elements of the suspensorium of the lower jaw. There is no sufficient evidence of affinity to the Nematognathi, which is probably a modern group.

The Mycteropidæ then occupy a position between the Antiarcha and Marsipobranchii (Monorrhina) on the one hand and the fishes on the other. They would, with the latter, enter the "cladus" Amphirhina of Hæckel, if that division be regarded as defined by the presence of two nareal orifices. But this disposition of them would violate truer affinities to the orders without lower jaw and scapular arch, for which the term Agnatha (Haeckel) may be retained. As compared with Cephalaspididæ, Mycterops approaches nearest to Didymaspis Lankester. The Mycteropidæ may be regarded as descendants of the Pterichthydidæ, and ancestors of the Placoganoidei. Since the latter occur earlier in geological time (Devonian) than the Mycteropidæ (Carboniferous), we may suppose that Mycterops is a descendant of a Silurian or Devonian type with a single median nostril, which will be a family of Monorrhina. From this hypothetical family the Arrhina (Cephalaspididæ, etc.) and the Marsipobranchii (lamphreys) may then be regarded as descendants. The former lost nares by degeneracy; the latter are degenerate in other respects.

EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— The editors of the AMERICAN NATURALIST wish to call the attention of American students to the fact that their pages are open for the prompt publication of summaries of the results of original investigation, which for any reason it may be deemed desirable to place on record before the issuance of the completed account. Looked at merely as a means of securing priority, preliminary communications are not over praiseworthy. The credit of making a discovery should not be the sole end of investigation, and an attempt to hurry into print so as to forestall some other worker in the same line is not highly meritorious. The student of science should have a higher aim; and happily quarrels for priority are far less frequent than they have been in years past, thus indicating that a higher end has been sought. Preliminary communications have another value than the mere anticipation of another. They place before others, working in the same line, an outline of the results at the earliest possible moment, and thus often furnish invaluable assistance. Fully as great is their value to the student working in another line. The completed paper is usually long and frequently prolix, so that it is a severe drain upon the time to wade through it for the facts desired. The preliminary communication, on the other hand, is usually short and concise; it contains only the more salient facts and omits the larger part of the speculations. In this way it becomes more easily available for reference, while it does not withdraw from the value of the more detailed article. From these two points of view the preliminary communication is valuable and deserves encouragement.

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RECENT LITERATURE.

SMITH'S "ALBATROSS" CRUSTACEA.[1]— The dredgings of the U. S. Fish Commission steamer *Albatross* are turning up a wonderful deep-sea fauna, and placing the work done by American students in this direction at least on a par with that done in Europe. In the present paper 107 species of decapods are recorded as having been taken in the collections of 1883 and 1884, and of these but two are described as new in the present paper. Novel-

[1] *Sidney I. Smith's Report on the decapod Crustacea of the "Albatross" dredgings off the east coast of the United States during the summer and autumn of 1884.* Rep. U. S. Fish Commis. for 1885, pp. 101, 20 plates, 1886.

ties are, however, but a slight test of the value of any contribution to science, and the present instance is no exception. The principal feature of this paper is the extent to which it increases our knowledge of the bathymetrical distribution of the forms enumerated, and points out the coincidences between depth of occurrence and points of structure. These lists record forty-three species as coming from below the 1000 fathom line, while twenty-two were taken from a depth greater than 2000 fathoms. The greatest depth recorded is 2949 fathoms, and from a single station of this depth, about 350 miles east of the mouth of the Chesapeake the trawl brought up *Acanthephyra agassizii*, *A. brevirostris*, *Notostomus vescus*, *Hymenodora glacialis*, *Parapasiphaë sulcatifrons*, *Hepomadus tener* and *Sergestes mollis*. Of the pertinence of the first of these to these great depths some doubt is expressed, as at another time one was caught swimming at the surface. All of these forms it is to be noted are macrurous.

Some of the deep-sea forms are colorless, but most are of some bright shade of red or orange. Their eyes have undergone a careful superficial examination. In some the black pigment, the corneal facets and the like are much as in shallow-water forms, except that occasionally the eyes are smaller. In Munidopsis and Pentacheles the visual elements are apparently lacking, while in others the pigment is light colored and the visual elements are reduced in number. In some of the deep-water shrimps there is a curious accessory organ borne on the eye-stalks which may be phosphorescent in its nature. It certainly deserves careful histological examination at competent hands. In the eggs, too, a peculiarity is noticed. Among the shallow-water decapods the eggs are usually so small that it is a matter of some difficulty to cut sections of them, but in these deep-water forms they attain a very considerable size, those of *Parapasiphaë sulcatifrons* having a diameter fifteen times those of the common soft-shelled crab, *Neptunus hastatus*.

We have a little fault to find with the present paper. The first is that which is found in all of the Fish Commission publications, but which here is not as bad as in embryological work—the use of process cuts. We notice a tendency to the creation of new families which hardly seems to be warranted. Until we know more of the morphology of the crustacean gill it hardly seems advisable to make gill-structure alone the basis of forming higher groups and separating widely species which are in all other respects closely allied.

SEDGWICK AND WILSON'S BIOLOGY.[1]—We have several guides to laboratory work in biology, but the great fault with all is that they stick too closely to the anatomical and developmental sides

[1] *General Biology*. By WILLIAM T. SEDGWICK and EDMUND B. WILSON. New York, H. Holt & Co. pp. VII + 193. 1886.

and almost entirely ignore the physiological aspect of animals and plants. A student has gained a valuable fact when he has learned the name and structure of any organ, but until he knows its function and the method in which it is performed his knowledge regarding it is incomplete. The present hand-book aims to teach the physiological as well as the morphological side, and thus fills a place which no other work in the English language does. It is, we understand, but a portion of what is intended, and this fact should be borne in mind in the following account. Still in its present condition it is admirably adapted for grounding students in biology. There are numerous exercises for the laboratory, and the directions for these are excellent; they tell the student what to do, but leave him to describe the results, thus giving the instructor a test of the student's progress.

The first three chapters are devoted to the phenomena of life and the study of organic matter, then follows a chapter on the cell, after which comes the study of special forms. Of these there are two, the fern—Pteris, and the earth-worm; and we agree with the authors in regarding these two forms as well adapted for study by the beginner as any. The book is well illustrated, most of the cuts being original, and though made by photo process they are usually clear and free from broken lines. A rather careful examination of the book reveals but little which calls for adverse criticism. On p. 123 it is stated that "all the organs of the body are originally developed from the walls of" the cœlom of the earth-worm, which is not true in the sense in which it will ordinarily be understood. Again one might criticise the use of "ectoblast" and "entoblast" (p. 178) for the inner and outer germ layers. Several other terms have priority, and it seems needless to multiply terms for each stage in the development of the organism. To be consistent the authors should replace the the term archenteron on p. 149 (not on 148) by mesenteron. The proof-reading has been very well done, and the typographical errors rare. The printer is, however, to be criticised, as he has used a badly worn font of type, and broken and battered letters are much too common. With the exception of these few points and a few of like character we have nothing but praise for the book.

WHITFIELD'S BRACHIOPODA AND LAMELLIBRANCHIATA OF NEW JERSEY.[1]—This quarto volume is occupied with the Brachiopoda and Lamellibranchiata of the Raritan clays and greensand marls. Only three genera of Brachiopoda, Terebratula, Terebratulina and Terebratella, occur in New Jersey, and only two species, *Terebratula harlani* and *Terebratella plicata*, are at all abundant. The plastic clays, some of the layers of which yield large numbers of

[1] *Whitfield's Brachiopoda and Lamellibranchiata of the Raritan clays and greensand marls of New Jersey.* By R. J. WHITFIELD. T. L. Murphy, State printing office, Trenton, N. J.

plant remains, furnish five species of lamellibranchs, three of which are new. The lower marl beds are much richer, and from them Mr. Whitfield describes a new Pecten, an Amusium, a Camptonectes and a Modiola, besides founding two new genera. New species of Inoceramus, Civota, Axinea, Nucula, Nuculana, Trigonia, Gouldia, Lucina, Diceras and several other genera are also described. To the fauna of the middle marls are added a Gryphæa, two species of Idonearca and a Modiola; an Ostrea, a Modiola, a Cardita, two Crassatellæ and one species each of Criocardium, Petricola, Veleda, Caryatis and Periplomya are added to the beds at the base of the upper marls, while fifteen new species enrich that of the Eocene marls. The concluding chapter contains an account of the Unionidæ from the clays at Fish House, Camden county, two new species are described. There are thirty-five full-page illustrations and a map.

RECENT BOOKS AND PAMPHLETS.

Prestwich, I.—On underground temperatures, etc. From the Proc. Roy. Soc. London, 1886.

——On the agency of water in volcanic eruptions. 1886. Both from the author.

Woodward, A. S.—On the relations of the mandibular and hyoid arches in a Cretaceous shark. Ext. P. Z. S., London, 1886. From the author.

Baur, G.—Ueber das Archipterygium und die Entwickelung des Cheiropterygium aus dem Ichthyopterygium.

——Ueber die Kanäle im Humerus der Amnioten. Both from the author.

Manigault, G. E.—The Black Whale captured in Charleston harbor Jan., 1880. Proc. Elliott Soc. From the author.

Frazer, P.—Report of the American Committee of the International Congress of Geologists. Ext. P. A. A. A. S., Aug., 1886. From the author.

Boettger, O.—Diagnoses Reptilium Novorum. Sep.-abd. a. d. Zool. Anz., No. 231, 1886.

— Zur Kenntniss der Neritinen Chinas. Ext. Jahrb. d. Deut. Malak. Gess., 1886. Both from the author.

Marshall, W.—Ueber die Knöchernen Schädelhocker der Vögel. Haarlem, 1872. From the author.

Leche, W.—Ueber einige südbrasilianische Hesperomys-Arten. Sep.-abd. a. d. Zool. Jahrb., 1886. From the author.

Walcott, C. D.—Classification of the Cambrian system of N. America. Ext. Amer. Jour. Sci., Aug., 1886. From the author.

Minot, C. S.—Notes on histological technique. From the author.

Call, E., and Pilsbry, H. A.—On Pyrgulopsis, a new genus of Rissoid mollusk, with descriptions of two new forms. From E. Call.

Call, E.—On certain Recent Quaternary and New fresh-water Mollusca. Rep. Davenport Acad. Nat. Sci., Vol. v, 1886. From the author.

Hennessy, H.—On the fluid state of bodies composing our planetary system. Proc. Roy. Irish Acad., 1886. From the author.

Ryder, J. A.—An exposition of the principles of a rational system of oyster-culture. Ext. Rep. Fish Com., 1886.

——On the development of viviparous osseous fishes and of the Atlantic salmon. Proc. U. S. Nat. Mus., 1885.

——On the development of osseous fishes. Ext. Ann. Rep. Com. Fish. and Fisheries, 1886.

——The development of the Mud-minnow, etc.

Ryder, J. A.—The development of Patella, etc.

——The early development of *Julus terrestris*, etc.

——The metamorphosis of the American lobster, etc. Amer. Nat. Extras, June, July, August, Sept.

——On the value of the fin-rays and their characteristics of development. Proc. U. S. Nat. Mus., 1886. All from the author.

Walker, H. D.—The gape-worm of fowls (*Syngamus trachealis*), the earth-worm its original host. Ext. Bull. Buff. Soc. Nat. Sci. From the author.

Crane, Miss A.—On a brachiopod of the genus Atretia, named in MS. by the late Dr. T. Davidson. P. Z. S., 1886. From the author.

Proc. Roy. Soc.—Obituary notice of Thomas Davidson, LL.D.

Eigenmann, C. H.—A review of the American Gasterosteidæ. Ext. Proc. P. A. N. S., 1886. From the author.

Eigenmann, C. H., and Fordice, M. W.—A catalogue of the fishes of Beau Blossom creek, Merton county, Ind. Ext. idem. From the authors.

Woodward, A.—A new locality for *Haplophragmium cassis*, a rare Foraminifer. N. Y. Micros. Soc., 1886. From the author.

Gaudry, A.—Sur au bois de Renne, orné de gravures, decouvert à Montgaudier. Comptes Rendus, July, 1886.

——Sur l'Age de la Faune de Pikermi, du Léberon et de Maragha. Ext. Bull. d. l. Soc. Geol., 1886.

——Sur un nouveau genre de Reptile trouvé dans le Permien d'Autun.

Albrecht, P.—Epiphyses entre l'occipital et le sphénoïde chez l'homme.

——Os trigone du pied chez l'homme.

——Epihallux chez l'homme.

Backhouse, J.—On a mandible of Machærodus from the Foster bed. Ext. Quar. Journ. Geol. Soc., 1886. From the author.

Lydekker, R.—Note on some Vertebrata from the Red Crag. Ext. Quar. Jour. Geol. Soc., Aug., 1886. From the author.

——Siwalik Mammalia. Supplement I. Palæontologica Indica, 1886. Both from the author.

Stowell, T. B.—The trigeminus nerve in the domestic cat. Amer. Philos. Soc., 1886. From the author.

Pelsener, P.—Notice sur les crustacés décapodes du mæstrichtien du Limbourg. Ext. Bull. Mus. Roy. Belg., 1886. From the author.

Brown, T.—Manual of the New Zealand Coleoptera. 1886. From the author.

Osborn, H. F.—The origin of the corpus callosum. 1886. From the author.

Morris, C.—Reverse vision. Proc. P. A. N. S., 1886. From the author.

Evermann, B. W., and Meek, S. E.—A revision of the American species of the genus Gerres. P. A. N. S., 1886. From the author.

Hoernes, R.—Table des Matierés du Manuel de Paléontologie, traduit par L. Dollo. Librariè F. Savy. Paris. From the publisher.

Dollo, L.—Note sur les ligaments ossifiés des Dinosauriens de Bernissart. Ext. Arch. d. Biol., Gand, 1886.

Dollo, M. L.—Noticè sur les Reptiles et Batraciens recuellis, par M. Storms dans la Region du Tanganyka. Ext. Bull. Mus. Roy. Belg., 1886. From the author.

——Premiére note sur les Cheloniens Landeniens (Eocene Inferieur) de la Belgique. Ext. Bull. Mus. Roy. Belg., 1886. Both from the author.

Shufeldt, R. W.—On injuries of the beak in birds, and methods of repair. Ext. Jour. Comp. Med., 1886. From the author.

Nat. Acad. Sci.—Report for the year 1885. Washington, 1886. From the department.

Ashburner, C. A., and Hill, F. A.—Report on the Bernice coal basin.

——Notes on the Mahoopany coal field.

Ashburner, C. A.—Borings for oil.

Lesley, J. P.—Pressure, quantity, composition and fuel value of rock-gas.

Carll, J. F.—Preliminary report on oil and gas. The last five, advanced copies from the Rep. Geol. Surv. Penna. From the survey.

Williams, A.—Mineral products of the U. S. 1885.

Dunwoody, H. H. C.—Monthly weather review, 1886. From the U. S. War Dept.

Selwyn, A. R. C.—Descriptive catalogue of a collection of the economic minerals of Canada. Colonial and Indian Exhibition, 1886. From the author.

Clarke, F. W.—Work done in the division of chemistry and physics 1884–5. Bull. U. S. Geol. Surv., No. 27.

Williams, G. H.—Gabbros and the associated Hornblende rocks. Bull. U. S. Geol. Surv., No. 28.

White, C. A.—Presh-water Invertebrates of the N. American Jurassic. Bull. U. S. Geol. Surv., No. 29.

Cope, E. D.—The Origin of the Fittest. 8vo. D. Appleton & Co. From the publisher.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—*The Ruins of Copan, etc.*—A. P. Maudsley (Proc. Roy. Geog. Soc., Sept.) has a lengthy article upon the ruins and site of Quirigua and Copan, Central America, the result of explorations carried on in 1883 and 1884. At Quirigua the chief interest centers in thirteen large carved monoliths which seem to have once adorned one of the principal plazas of the Pueblo. These ruins are twenty-five to thirty miles northwest of Copan. The account gives the earliest authentic description of the ruins, that of Diego de Palacio, written in 1576. Mr. Maudsley maintains that almost all the so-called pyramids of Copan are the raised foundations which supported roofed buildings, probably temples; and that the long heaps of stones which have been taken for city walls are really the remains of single-chambered stone-roofed houses which were raised on foundations only a few feet high. The group of terraces which seem to have supported the principal edifices was cleared by the explorer, whose account is accompanied by plans and sketches. The largest mass occupies an area nearly equal to that of the great pyramid at Ghizeh, and is built of a rubble of rough blocks of stone and mud with binding internal walls of faced stone and cement, and an outer casing of well-worked stone, often elaborately sculptured. The stone casing is usually in great steps, some of which are eight feet in breadth and height. Although no roofed buildings now remain, stones cut to a bevel, such as would be suitable for the construction of horizontal arches like those of Tikal, were found. Our author maintains that Copan, Quirigua, Palenque, Tikal and the ruin on the river Usumacinta were abandoned before the Spanish discovery of America. Palacio's letter shows them to have been ruins in 1576, and proves that the Indians then living had no knowledge of the builders, and were themselves without skill to execute such works. Mr.

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

Maudsley describes the ruins of a town which he believes to have been the Chacujal of Cortez. Here the houses are of the same long and narrow form but were roofed with thatch, and are of inferior construction.

American News.—Up to August 27, fifty-three sheets of the general topographical atlas of the United States have been published. The forces of the Geological Survey are at work in Massachusetts, Northern Virginia, Central Arizona, and in the gold region around Oreville.——Two topographic parties and one hydrographic party are, according to "Science," at work on the re-survey of San Francisco bay. The Coast Survey is also at work on the transcontinental arc, with telegraphic longitude parties at Salt lake and Ogden.

EUROPE AND ASIA.—*Lake Leman.*—From a paper read by Professor Forel before the Association of Swiss Geographical Societies, it appears that there are two parts in Lake Leman, one small and shallow, the other large, deep and Alpine in its character. The two are separated by the Yvoise bank or bar, which is really a glacial moraine, as shown by the flints dredged up. Knowledge of the central portion of the lake is still very incomplete. The fragments of rock, sometimes brought up from a depth of sixty-one metres, are covered with moss of a beautiful green—a fact that seems to show that light penetrates to that depth. It has been discovered that the river Rhone flows in a sub-lacustrine ravine.

The Pamir.—The last issue of the Izvestia of the Russian Geographical Society contains a map of the upper course of the Amu-Daria between the 36th and 41st degrees of latitude, and the 66th and 76th degrees of longitude. The whole of the Pamir appears on this map according to the recent surveys and barometric levelings of the Pamir expedition, while a number of other surveys are taken into account.

M. Krendowsky (Memoirs Kharkuff Soc. of Naturalists) devotes a paper to the estuaries of the Bug, Dnieper, and other smaller ones in the neighborhood of Kherson and Odessa. He gives the character and geological history of these estuaries, which are now shut off from the sea by their sand-bars, and have become mere elongated salt lakes.

The Geographical and Statistical Dictionary of the Russian Empire, commenced more than twenty years ago, is just completed. Its great value, says Nature, is in the excellent geographical descriptions of the localities treated, including not only each separate government of Russia, Siberia, Turkestan and the Caucasus, but of the seas that border Russia, and of their islands. The geology, fauna and flora have also received much attention, and there is a complete bibliography. An appendix is promised, giving descriptions of regions such as the Thian-Shan, Ferganah,

and Transbaikalia, which were much explored during the publication of the dictionary.

PACIFIC ISLANDS.—*Captain Bridges' Cruises.*—Captain C. Bridges' notes upon cruises among the Pacific islands (Proc. Roy. Geog. Soc., Sept.) give a good idea of the present condition of the islands visited. In the southern section of the New Hebrides the temperature ranges from 62° in July and August, to about 92° in January and February. The natives of Aneiteum are devout Christians. Among the Melanesians of these islands, communities of Polynesians preserve themselves distinct. The staple product is *copra*, the dried pulp of the coco-nut, and several white traders are engaged in procuring it. On Sandwich or Vaté, the women shave their heads completely, while on Espiritu-Santo they leave a ridge of hair from poll to forehead. The houses are neat and clean; on some islands the unmarried men sleep in a special house.

The people of the Solomon isles are good seamen. Their canoes, except as New Britain and New Ireland are approached, have no outriggers. The New Britain people go quite naked, and lack the vigor of the Solomon islanders. They are the only cannibals of the region who are not ashamed of their cannibalism. It is not etiquette in New Britain to ask a man his name, it should be asked of some one else. Captain Bridges mentions a curious mode of shark-catching practiced by the Kingsmill islanders. They tow from a canoe a large line with an open noose. Through the centre of the noose is passed a small line with a bait on the end. As the shark follows the bait, it is hauled in, until at last the fish has his head in the noose, which is quickly tightened. The people of the Ellice islands are all Episcopalian Christians, while those of the Gilbert islands are partly Christianized.

The Marshall island men are tall, the women singularly short. The dress of the latter consists of two ornamented mats tied around the hips so as to resemble somewhat a sleeveless and low-necked gown. On these islands and some of the Carolines the women tattoo the hand and fore-arm in such a way that they appear covered with open-worked mitts. The money of Yap (Carolines) is in the form of disks of arragonite, like great grindstones. They are quarried in the Pelew islands, and some pieces weigh three tons. The people of Nicguor and Greenwich islands, two low atolls of the Carolines, are almost gigantic, and are now ruled by queens. In the Pelew islands the younger men have large "club-houses." Women may not enter the club-house of their own village, but may without losing caste visit that of the next. The constitutional government of Tonga seems to be a success. Most of the Tongans are now fearless horsemen, though many can remember the time when there was not a horse in the Archipelago. The people of the Louisiades are in physique and knowl-

edge of the arts inferior to both the light and dark races of S. E. New Guinea. The peculiarity of macrodontism, *i. e.*, the extension of one tooth over the space usually occupied by two or three, was noticed among the men of Rossel island. While in the south of New Guinea the natives are in the stone age, in the north they use shell implements.

The New Zealand Earthquake.—Dr. Hector's preliminary report upon the recent volcanic eruption in New Zealand enable some idea to be formed of the magnitude of this convulsion of nature. The outbreak commenced at half-past two on the morning of June 10th, by an eruption from the top of Wahänga, the northernmost summit of the Tarawera range. This was in a few minutes followed by a more violent outburst from the summit of Ruawahia, the central peak of the same range, and this was shortly afterwards followed by a terrific explosion from the south end of Tarawera itself. For two hours vast quantities of steam, pumice-dust and stones were poured out. A great crack or fissure was formed along the east face of the mountain, and Mr. Percy Smith reports that the whole east end was blown away, the débris covering the country for many miles. Up to this time the earthquake shocks which occurred were not very violent, but about 4 A. M. came a powerful earthshock, attendant on the outburst of an immense volume of steam from the site of Rotomahana lake. By 6 A. M. the period of active eruption had passed; but the town and vicinity of Wairoa were smothered in the mud condensed from the cloud of steam and solid matter thrown up from Rotomahana.

The formerly abrupt sides of Tarawera are now everywhere softened by great slope deposits of material ejected from a range of volcanic vents, seven of which were in a mild state of eruption when visited by Dr. Hector. From the south-western extremity of Mt. Tarawera a great fissure runs south-westward for some seven miles. The eastern side of this has a nearly straight wall, but the western is very irregular and is continually altered by the falling in of its walls as they are undermined by the action of seven powerful geysers which at irregular intervals throw up great volumes of boiling water, stones and mud to a height of 600 to 800 feet. Lake Rotomahana has disappeared in this chaos. The largest mud geyser occupies the site of the Pink terrace, another that of the White terrace. At its northern end this fissure commences in a great rent 2000 feet deep, 500 wide, and 300 deep on the side of Tarawera, and the southern end is a bold semicircular escarpment. No fissure or fault seems to continue beyond the depressed portion, which seems to be entirely due to the removal of material. One mud geyser, about a mile south of the Pink terrace, is on comparatively high ground, and has built up for itself a mound which was several hundred feet high a few days after the chief eruption.

All the fragments found seem to be of local rock, though eye witnesses state that they reached the ground in a partially incandescent state. Dr. Hector concludes the eruption to have been a purely hydro-thermal phenomenon on a gigantic scale, but quite local in character.

AFRICA.—*African News.*—Lieut. E. Gleerup, a Swede in the service of the Congo Free State, has recently crossed Africa from the Congo to Zanzibar. He had been left for nearly a year without supplies at the remote station at the seventh cataract of the Stanley falls, and finally left for Europe by the aid of funds furnished by Tippoo Sib, the rich Arab trader. The journey to the east coast occupied six months.——Reports by the late Sir P. Scratchley, British Special Commissioner to New Guinea, gives a description of the characteristics of the natives of different portions of the coast of British New Guinea. The littoral seems to be well inhabited, except some portions of the north-east coast. Two rivers, the Davadava and Hadava were discovered in Milne bay, the latter river a large one.——Dr. Paulitschke writes, in the Mittheilungen of the Geographical Society of Vienna, upon the two hydrographic problems of the Somali peninsula, that of the Upper Webi, and that of the Juba. He believes that we must seek the source of the Webi in one of the lakes of Gurage.

GEOLOGY AND PALÆONTOLOGY.

NOTICE OF GEOLOGICAL INVESTIGATIONS ALONG THE EASTERN SHORE OF LAKE CHAMPLAIN MADE BY PROFESSOR H. M. SEELY AND PREST. EZRA BRAINARD.—In this paper is announced the discovery of quite an extensive new fauna in limestones, apparently of the age of the Birdseye limestone of the New York series, near the mouth of the Otter creek, Lake Champlain, which is of much interest owing to the fact that only about fifteen species of fossils have hitherto been known from the formation. The new forms described in the paper from this one bed are fifteen in number, comprising one Brachiopod, six Gasteropods and nine Cephalopods. One of the Gasteropods has given reasons for the establishment of a new genus, Lophospira, with *Murchisonia bicincta* Hall, and *M. helicteres* Salter, as the types. The bed of limestone in question is associated in the vicinity with recognized Chazy, Birdseye and Black River limestones, and holds a position considerably above the Maclurea beds of the Chazy close by. A close comparison of the fossils shows a much nearer relation with the form of the Birdseye and Black River than with the Chazy; the known species being principally from the Birdseye. *Orthoceras bilineatum* Hall, *Maclurea affinis* Billings and *M. logani* Murch., *Asaphus canalis* Conrad, *Bathyurus extans* Hall, *Harpes ottawaensis* Billings and *Illæma crassicauda* (Wahl.) Hall. The Asaphus is known in the Chazy as well as in the Birdseye, and

the Harpes was described originally from the Trenton. About the specific identity of the latter there is yet some doubt.

Besides the fossils already mentioned, the paper also includes descriptions of another new genus of gasteropod—Calaurops (a shephed's crook), for a form collected in a bed some twenty-five or thirty feet below and just above the Maclurea bed, having the form of a Euomphalus in the inner coils, but afterward becoming deflected in a straight line to the extent of six inches. Also two Trilobites and a Cyrtoceras from the Birdseye of Isle La Motti.

Since the meeting at Buffalo and during the week previous, the author of the paper, in conjunction with the persons named in the title of the paper, have made other collections at the same locality, which has resulted in the discovery and determination of several other species, the descriptions of which are nearly ready for the press, and illustrations of them for the engraver. The fauna of the Birdseye limestone at that locality is known now to consist of the following group of fossils:

Genus Orthis	1	species,	resembling O. perveta Con.
Streptorhynchus	1	"	new.
Leptæna	1	"	"
Triplesia ?	1	"	?
Maclurea	2	"	affinis and logani.
Euomphalus	1	"	new.
Helicotorna ?	1	"	"
Holopea	2	"	"
Subulites ?	1	"	"
Murchisonia	2	"	"
"	1	"	gracilis Hall ?
Lophospira	1	"	new.
Clisospira	1	"	"
Ecculiomphalus	1	"	"
Tryblidium ? or a new genus, 3 species, new.			
Bellerophon	1	species, new.	
Orthoceras	2	"	"
"	1	"	bilineatum Hall.
"	1	"	?
Piloceras	1	"	new.
Gomphoceras	2	"	"
Cyrtoceras	2	"	"
Nautilus	2	"	"
Lituites	3	"	"

Crustacea:

Genus Ribiera 1 species, new.
Asaphus canalis Conrad.
Bathyurus extans Hall.
Harpes ottawaensis Billings ?
Amphion 1 species, new.

Giving a total of forty recognized species in a condition suita-

ble for description and illustration, of which the new ones are shortly to appear in a Bulletin of the Am. Mus. Natural History, with a description of the geology of the region by Professors Seely and Brainard.—*R. P. Whitfield.*

THE VEINS OF SOUTHWESTERN COLORADO.[1]—It is quite impossible to thoroughly understand the complicated vein-structure of the San Juan region without an intimate knowledge of the geological history. The details of the stratigraphy are very interesting, but we cannot stop to review them here. Suffice it to say that the succession of the strata, aside from local features of little importance for our present purpose, is much the same as in typical sections from the Rocky mountains through Wyoming and Northern Colorado.

The real vein-history begins with the close of the Cretaceous age, when the great folds took place which afterwards became the seat of volcanic action. I must refer to the previous papers read at this meeting of the Association for much of what might properly be brought into discussion here, and we may at once proceed to a brief description of the veins and their arrangement.

In the period of the andesitic outflows the country comprising the great San Juan Central area was so situated that the lavas did not cover it, and much of this material did not reach the surface, but it was forced in between the limestone and other rocks as intrusive masses. The general course of the fissures was along the primary longitudinal folds (N. 18° E.), and the veins were produced in fault crevices. Owing to the greater age of the deposits and their frequent intrusive character, there is considerable variety in the mineral contents and in the cross-sections of the veins. The earliest appear to be those of the La Plata district, with those of the Rico tract and the Summit district originating, perhaps, somewhat later. The first named are characterized by the abundance of gold, both free and in tellurides and similar compounds; the Rico area is peculiar from its close relationship to the Carboniferous limestones, resulting in the formation of carbonated ores, though in other respects this belt is very near the La Plata tract in its genesis; the Summit district is widely separated from these two basins, and has been the seat of much secondary action, so that the date of its initial stages in vein-formation is difficult to determine, but with results similar to those of the latest epoch. I am strongly of the opinion that the genesis was but little, if any, later than that of the other two sets.

In the Central San Juan area the complexity is very great, and yet the distribution of the veins may be brought into order in a beautiful system with surprising regularity in the grouping. There are six radial zones passing out from Red peak (the geyser

[1] Paper read before Section E, A. A. A. S., Buffalo, 1886.

basin described at the Buffalo meeting in another paper) and extending as far as the confines of a depressed area which was caused by faulting in the trachytic period. These zones are traversed by central, nearly vertical veins ("*parent fissures*," as I have elsewhere styled them), bounded upon each side by veins converging laterally and from above downwards. The mid-ribs are free-gold bearing, and they represent three trends intersecting near Red peak. These trends are about N. 80° E., N. 38° E. and N. 38° W. The zones vary in width, but between each two there is a barren belt of greater or less breadth. Beginning at the north we have (1) the *arsenical* zone, characterized by minerals carrying high percentages of arsenic; (2) the *bismuth* zone; (3) the *galena-gray copper* zone; (4) the *antimonial* zone, practically the prolongation south-westward of the arsenical wedge; (5) the *argentiferous-galena* zone, opposite the bismuth wedge, and (6) the *sulphuret* zone, a wide area with few veins, but these rich and carrying true silver minerals (sulphides) largely.

The faults and the vein-filling appear to have occurred subsequently to the trachytic ejections but prior to the rhyolitic period. The evidence is that the gradual elevation of the Red peak focus caused the subsidence and faulting along the edges and across two of the three stated radii of the depressed area, but that the deposition of the veins along the arsenical-antimonial trend was later than the rhyolitic period, or in its closing stages. After this the veins of the Red Mountain area were much modified by the secondary action of hot springs and geysers.

I have given here the mere outline of the facts, and but a small part of what has been put into other publications, but minute details can not be presented in this place.

It is, however, important to note that much material has been collected bearing more or less directly upon the source of the vein-stuff, and that the conclusion is imperative that local segregation from the volcanic rocks is wholly untenable. The idea that the veins in the volcanics have been derived from preëxisting ore-deposits in the subjacent metamorphics is quite as wide of the facts, and there can be no doubt of the deep-seated origin of the lodes at a period coincident with the igneous action.—*T. B. Comstock.*

A GIANT ARMADILLO FROM THE MIOCENE OF KANSAS.—The museum of the University of Kansas, at Lawrence, contains a portion of the dermal skeleton of an armadillo, probably of the family Glyptodontidæ, from the Loup Fork formation of that State. I owe the opportunity of examining and describing it to my friend, Professor Francis Snow, of that institution. The species appears to belong to a genus distinct from those known to belong to the Glyptodontidæ, which I shall call Caryoderma. Its peculiarity consists in the fact that a portion of the carapace

is represented by osseous nuclei only, which do not articulate with each other. The scuta belonging to the tail are distinct from each other, and not coössified as in Dædicurus. The species may be named and described as follows:

Caryoderma snovianum Cope, sp. nov.—The dermal scuta may be arranged in four classes. First, the smallest, which are subquadrate in outline, and flat; one of the flat faces, probably the internal, smaller than the opposite one, and more spongy. Six of these; the largest 15^{mm} in width. Second, larger scuta, subhexagonal or pentagonal, or oval, with the dense smooth external face rising towards and produced beyond one of the borders of the base as a flat more or less angular cornice. This cornice is separated from the border of the basal part of the bone by a rabbet or open groove. Inferior surface perforated by foramina. Edges finely rugose. Of this type there are seven scuta. Dimensions of largest, length 32^{mm}, width 35^{mm}. The third type resembles the second, but the cornice is represented by a conical elevation which does not project beyond the edge of the base, but stands above or within it. Inferior surface more or less concave. Size of largest, length 40^{mm}, width 33^{mm}; of smallest, 15^{mm} by 14^{mm}. Four large and three small. The fourth kind of dermal bone is an acute cone with a small convex base, more or less obliquely truncated. Four of these, two large and two small. Measurements of former, base 28^{mm} by 22^{mm}, total elevation 32^{mm}; measurement of smaller kind, base 15^{mm} by 11^{mm}, total elevation 22^{mm}.

It is probable that the third kind of plate belongs to the tail, where they enter into the composition of the annuli, as in Glyptodon and Hoplophorus. Processes resembling the fourth kind are found on the superior middle line of the tail in Hoplophorus, and also along the inferior edge of the carapace.

An ungual phalange is of interesting form. It is hoof-like, longer than wide, and squarely truncate at the extremity without notch. The superior surface is convex in transverse section, and straight in profile, which rises behind. The inferior face is flat for the distal two-thirds; the proximal two-thirds rising to the articular surface. The latter is not wider than the distal extremity, the surface expanding and forming a shoulder one-quarter the length distad of it. Articular surface concave vertically, a little convex transversely. Total length of phalange 32^{mm}, greatest width 24^{mm}, greatest depth 17^{mm}; width of extremity 14^{mm}; of articular facet 15^{mm}.

The discovery of this form in the Loup Fork bed of Kansas is of much interest on several accounts. First, it is the first time this group of Edentata has been discovered north of the valley of Mexico. Secondly, as belonging to an earlier epoch than the Pampean Glyptodontidæ of South America, Caryoderma stands in the position of ancestor. Thirdly, the rudimental character

of some of the segments of the carapace shows the latter to have been undeveloped, which is further consistent with a relation ancestral to the other armadillos. It is probably a case of persistence, however, for since the Miocene beds of the Parana have been shown by Ameghino to contain ancestral Glyptodontidæ, the North American ancestors of these are to be sought in beds earlier than the Loup Fork. The species was discovered by Mr. Charles H. Sternberg, in Northern Kansas. It is respectfully dedicated to Professor F. H. Snow, of the university of that State.

GEOLOGICAL NEWS.—*General.*—In these days of earthquake theories that of M. De Montessus (Rev. Scient., 1886, 369) is worthy of notice. He starts by enumerating the three chief theories of the constitution of the earth: (1) A central fluid nucleus with a more or less thick crust; (2) a central solid nucleus and a solid crust separated by a spherical liquid ring; (3) a solid interior with chambers filled with fluid. Postulating the correctness of the first theory, which prevails in France and holds its own in other countries, he then gives, as the result of calculations made upon 4943 shocks, the statement that earthquakes are more frequent when the moon is on the meridian than when it is at right angles with it. From this he passes to the fact that were the ocean composed of a dense fluid, like mercury, the tides would consist of an actual transport of matter following the moon's course. May not such tides take place below the earth's crust? Capt. Boulanger, in 1880, dared to doubt that the earth moved as a whole, so that the velocity of every point is proportional to its distance from the center. The patient study of the sun spots has proved that there is in the sun's matter an internal and external circulation quite different from that which would result from a rotation in every point proportionate to the radius. Vortex motions, according to M. Faye's law, must be produced in fluids the layers of which are in movement with slightly differing velocities. Add these vortex movements to the subterranean lunar tides, and M. Montessus' earthquake theory is outlined.

Palæozoic.—Professor Ed. Hull, Mr. Mellard Reade and others in Britain, with Mr. Crosby in America, maintain that in Palæozoic times the North Atlantic and the North American continent in the main changed places. In the words of the first of these: "If it be allowed as a general principle that the originating lands lay in the direction towards which the sediments thicken, and opposite to that in which the limestones are most developed, the conclusion is inevitable that the Atlantic was, in the main, a land surface in Palæozoic times."

Permian.—M. Alb. Gaudry describes *Haplodus baylei*, a reptile from the Permian beds of Telots, near Autun (France). The name is derived from Greek words which signify the close adhesion of the teeth to the maxillaries. Three other types of rep-

tiles, Actinodon, Protriton and Stereorachis, are now known from these beds.

Secondary.—The central region of Tunis, according to M. Rolland, consists in great part of a mass of senonian beds with limestones yielding inocerami and cephalopods. This mass is here and there capped by nummulitic beds. These beds are found all around the Mediterranean region, but those of Algiers and Tunis are characterized by peculiar species.——M. Thomas has discovered beds of phosphate of lime in Tunis. In the south-west are rich and very extensive Eocene deposits, while near Feriana there is a small bed of Cretaceous age. In the Albian marls of Constantine, in Algeria, there are notable Cretaceous beds of this mineral.

Quaternary.—M. Reviere, who at the meeting of the French Assoc. Adv. Sci. at Grenoble, in 1885, gave a list of 171 shells discovered in the grottoes of Meudon, has this year described the fishes and birds. The few fishes found are principally those of fresh water, which seems inexplicable among peoples living on the shore of a sea so rich in fishes as the Mediterranean. The vertebra of a salmon, a fish of the northern rivers, was found, and speaks of the migrations of these Quaternary peoples.

MINERALOGY AND PETROGRAPHY.[1]

New Books.—The third part of Professor von Gümbel's "Geologie von Bayern"[2] has just been received. Although not yet completed, enough of the first volume has already appeared to show that the work in its entirety will fill a long felt want. In this volume the author proposes to set forth the principles of geology as generally accepted at the present time, devoting quite a considerable portion of the book to the microscopical characteristics of rocks, and to the truths which the microscope reveals, as well as to the theories to which the use of this instrument has given rise. That portion of the book which has already appeared is well illustrated by nearly four hundred photo-engravings. Most of these illustrations are taken from localities in Bavaria. The author, however, has not hesitated to draw on any source that would serve his purposes better than those at hand in his own country. The result is a most satisfactory text-book of geology, in which all the most modern methods of geological research are described, and the results to which each leads carefully given. The subject of metamorphism has received considerable attention and also the theories relating to "petrogenesis," or the origin of rocks. The second volume will be devoted to a description of the geology of Bavaria.——The first of a series of monographs on edu-

[1] Edited by Dr. W. S. Bayley, Madison, Wisconsin.

[2] Geologie von Bayern. Bd. I, Lief, I, II, III, Grundzüge der Geologie. Dr. K. W. von Gümbel. Cassel, 1884-6.

cation has recently been published by Heath & Co., of Boston.[1] It is a neat little book of thirty-five pages, intended primarily to call the attention of teachers to the rise and development of the youngest branch of geological science, and to the methods which are made use of in it. A very large amount of information relating to the history of petrography is embraced within the first twenty-five pages of this little volume. The next five pages contain a list of the most important works devoted to the subject and the periodicals in which petrographical articles are published. In the remaining pages the methods made use of in the preparation of thin sections are described and the names of reliable dealers in the instruments and materials used, with the cost of these, given.

MINERALOGICAL NEWS.—Ptilolite[2] is a new mineral, described by Cross and Eakins, from Colorado. It occurs in the cavities of a vesicular augite-andesite found as fragments in the conglomerates of Green and Table mountains, in Jefferson county. It forms delicate tufts and spongy masses composed of short hair-like needles which are usually deposited upon chalcedony in the pores of the rock. Under the microscope these needles are seen to be colorless, transparent prisms about .001^{mm} in diameter, terminated by a basal plane. Their extinction is parallel to the prismatic axis. An analysis of the purified material yielded Mr. Eakins the following result:

SiO_2	Al_2O_3	CaO	K_2O	Na_2O	H_2O
70.35	11.90	3.87	2.83	0.77	10.18

This corresponds to the formula Ro Al_2O_3, $10SiO_2 + 5H_2O$. The mineral is interesting as being the hydrated form of the most acid anhydride known among the silicates, with the exception of the rare mineral milarite.——A pseudomorph of limonite after pyrite[3] recently found in Baltimore county, Maryland, contains six of the seven possible crystallographic forms of the regular system. The forms actually observed are O, $\infty O\infty$, $\left[\frac{\infty O2}{2}\right]$, $\left[\frac{4O2}{2}\right]$, 2O2, and 3O. The fact that only two planes of the forms $\left[\frac{4O2}{2}\right]$, 2O2, and 3O are developed in each octant imparts to the crystal an orthorhombic symmetry.——The turquoise from Los Cerillos, New Mexico, has been studied chemically and microscopically by Messrs. Clark and Diller,[4] of the United States Geological Survey. It occurs imbedded in a fine-grained red orthoclase rock with a microgranitic structure, sometimes in

[1] Modern Petrography. An account of the application of the microscope to the study of Geology, by G. H. Williams, 1886.

[2] Whitman Cross and L. G. Eakins. Amer. Jour. Sci., XXXII., Aug., 1886, p. 117.

[3] On a remarkable crystal of pyrite from Baltimore county, Md. Geo. H. Williams. Johns Hopkins Univ. Circulars, No. 52, 1886.

[4] Amer. Jour. Sci., XXXII., Sep., 1886, p. 211.

nodules, but more frequently in seams and veins. In color it ranges from sky-blue, through greenish-blue, to dark-green. Analyses of specimens of these three varieties yielded:

	Bright blue.	Greenish blue.	Dark green.
H_2O	19.80	19.60	18.49
Al_2O_3	39.53	36.88	37.88
Fe_2O_3		2.40	4.07
P_2O_5	31.96	32.86	28 63
CuO	6.30	7.51	6.56
SiO_2	1.15	.16	4.20
CaO	.13	.38	

Upon comparing these results with those obtained by other investigators, the authors conclude that normal turquoise can be represented by the formula $Al_2 HPO_4 (OH)_4$. The various colors which it possesses are probably due to the admixture of a copper molecule $2CuO\ P_2O_5\ 4H_2O$. The presence of iron salts would tend to give a greenish tinge to the mineral. Under the microscope it was seen to be composed of minute grains or short thick fibers, weakly doubly refracting, with a high refractive index. The extinction was parallel to the long axes of the fibers. A consideration of the arrangement of the fibers in the veins, the composition of the rock in which the mineral is found, and its association with epidote, lead the authors to the supposition that it may have been derived from apatite.[1]

PETROGRAPHICAL NEWS.—The gabbros occurring near Baltimore, and the hornblende rocks associated with them have been made the subject of a bulletin of the U. S. Geological Survey.[2] The treatment of these rocks by the author is very thorough. The paper opens with an introduction calling attention to the fact that eruptive rocks may, under the influence of heat and pressure, become schistose and in their characteristics very like the crystalline schists which have been derived by the alteration of aqueous formations. The main portion of the work is devoted to the tracing of hypersthene gabbro into a schistose rock, called by the author gabbro-diorite. The massive gabbro consist essentially of a fine to coarse grained mixture of bytownite, light-green diallage and hypersthene in varying proportions. In addition to these there are also contained in the gabbro a little yellowish-brown hornblende, strongly pleochroic and full of minute black inclusions,[3] some magnetite and in a few instances considerable apatite. By alteration of the diallage and hypersthene into a fibrous hornblende the gabbro passes gradually into a schistose rock, containing in addition to the plagioclase and hornblende a considerable amount of epidote and some garnet, apatite, rutile, sphene, etc. In the case of the alteration of hypersthene the author supposes a reaction to have taken place between this

[1] Cf. AMERICAN NATURALIST, January, 1886, p. 61.
[2] Dr. G. H. Williams, Bulletin of the U. S. Geol. Survey, No. 28.
[3] Cf. AMERICAN NATURALIST Notes, March, 1886, p. 275.

mineral and the feldspar of the rock, the latter supplying the former with the necessary aluminum required to build up the hornblende molecule. In addition to the two rocks mentioned, there are in the same region olivine-bronzite-gabbros, feldspathic peridotites and lherzolites. In some of these rocks the feldspar has undergone a rather unusual alteration, viz., into scolecite. Other rocks, composed entirely of bronzite or hypersthene with or without diallage, are mentioned and briefly described. These olivine and pyroxenic rocks have given rise to much of the serpentine so generally found in their neighborhood.——In the August number of the American Journal of Science, Mr. J. S. Diller[1] has an article on the peridotite of Elliott county, Kentucky. This rock, according to the author, occurs in well-marked dykes cutting Carboniferous sandstones and shales. A microscopic examination shows it to consist of olivine and pyrope, with a small amount of ilmenite as primary constituents, and serpentine, dolomite, magnetite and octahedrite as secondary minerals. The interesting fact is noted that around the garnet a reactionary rim exists analogous to the kelyphite[2] of Schrauf. Instead of amphibole, however, the fibrous mineral in the rim is biotite. From a comparison of the composition of the peridotite and the intersected sandstones and shales and the discovery of both endomorphous and exomorphous changes (mica and spilosite in the shales, and a variolitic structure in the peridotite) in the neighborhood of their contact, the author concludes that the peridotite is without doubt an intrusive mass and eruptive in its origin.—— Mr. Geo. F. Becker[3] has replied to the article of Messrs. Hague and Iddings[4] on crystallization in the igneous rocks of the Washoe district. The author of the present paper denies the validity of many of the results of Messrs. Hague and Iddings, and claims that a second visit to the Washoe region and a reëxamination of the rocks collected there have established him firmly in the belief that the granitoid and the glassy rocks are of entirely distinct eruptions, which took place at two different periods remote from each other, and that in many cases minute differences of chemical composition have produced effects greater than moderate differences in the depths at which the rocks cooled. He moreover claims that a mere study of the slides and hand specimens is not sufficient to overthrow his own theory of the succession of rocks in the vicinity of the Comstock lode.——Professor R. D. Irving, of the United States Geological Survey, in an article in the American Journal of Science,[5] maintains that the iron ores and the associated jaspery schists of the Lake Supe-

[1] Amer. Jour. Sci. XXXII, Aug., '86, p. 122.
[2] Cf. AMERICAN NATURALIST Notes, Feb., 1886, p. 161.
[3] Bulletin 6, California Academy of Sciences, p. 93.
[4] Cf. AMERICAN NATURALIST Notes, Dec., 1885, p. 1216.
[5] Origin of the ferruginous schists and iron ores of the Lake Superior region. Amer. Jour. Sci., XXXII., Oct., '86, p. 255.

rior region were derived from an original iron carbonate which was interbedded with carbonaceous shales which were themselves often impregnated with the same mineral. By a process of silicification these carbonate-bearing layers were transformed into the various kinds of ferruginous rocks now met with in this region. In some cases silicifying waters decomposed the iron carbonate in place, producing tremolite or actinolite and magnetite, which with the excess of silica remaining formed the actinolitic schists so frequently found associated with the iron ores. In other cases direct oxidation of the carbonate gave rise to bodies of hematite. In still other cases during the silicification of the rocks and the decomposition of the carbonate, the iron was removed by leaching and deposited in other places as it became oxidized. The jasper is supposed to be secondary and to have been deposited upon the removal of the iron carbonate in the process of silicification. The various theories which have heretofore been put forward to account for these interbedded iron and jasper layers are all in turn examined and pronounced insufficient to explain the phenomena met with everywhere in the study of the region.

BOTANY.[1]

THE WIND AND THE TREE-TOPS.—Since 1875 the writer has observed, in various parts of the country, 156 instances of injury to the trunks or branches of trees by wind.

Of all ordinary trees the common red maple appears to suffer most in hard winds, and the whole 156 observed cases of injury were confined to the various species of deciduous trees. The writer has seen hundreds of long-leaf pines in Georgia and Florida that had been blown up by the roots, but not one injured in trunk or branch while the tree was yet standing. Also close inquiry in Iowa and a whole summer's observation among the white pines of Tennessee failed to reveal a single case in which a tree of that species was injured by the wind. Of the 156 observed instances of injury sixty-one per cent were limbs split off at the crotch.

The crotches of a tree are its weak points. Nature recognizes this fact and guards against the weakness by swelling out the wood about the points of branching. Notably is this true of the white pine. In a large tree of this species the limbs come out in regular whorls about two feet apart. Midway between each two successive whorls the central axis of the tree has a minimum size. Above and below this point of least circumference the trunk gradually swells out to support the successive sets of branches.

In sixty per cent of the observed injuries the trunk divided into two or more large nearly equal branches, and one of these

[1] Edited by Professor CHARLES E. BESSEY, Lincoln, Nebraska.

was the injured member. These large limbs, swaying in a hard wind, act as great levers, and are frequently not sufficiently supported at the crotch.

The meaning of all this is that a tree of which the trunk habitually divides into large nearly equal branches is much more liable to be injured by the wind than one having a strong central axis with many small limbs as, for example, the white pine.

Thus the accumulated effects of the wind have undoubtedly been to develop excurrent forms of tree-top. But the question naturally arises why pines, spruces, etc., have this form in greater perfection than other trees. Well, in the first place deciduous trees are usually injured by the wind only while in foliage during the summer months; but evergreens, being always in foliage, are practically exposed to the action of the wind for at least twice as great a time each year as are maples, elms, etc. Then too, according to palæontology, the cone-bearing evergreens came into existence many thousands, perhaps millions, of years before any tree that annually sheds its leaves. Thus the coniferous evergreens have had a vastly longer time in which to accumulate the effects of the wind and develop an excurrent form of top than have deciduous trees.—*B. F. Hoyt, Manchester, Iowa.*

A Hybrid Apple.—Recently a student brought me a "Ben Davis" apple characteristically marked throughout a little less than three-fourths of its surface, the remainder (a wide crimson streak from stem to calyx) having undoubted marks of the "Jonathan" variety. The tree from which it came is a "Ben Davis," and a "Jonathan" tree stands within a distance of several rods. Upon cutting the apple it was found that the hybridization was confined to two carpels, and that the development of the flesh of these and the corresponding calyx-segments had been somewhat greater longitudinally and considerably less transversely than for the remaining carpels. Upon tasting the flesh of the "Jonathan" part of the apple it was found to differ quite perceptibly from that of the "Ben Davis" part.

It is probable that we have in this apple an example of the immediate effect of the pollen upon the fruit. In this case the "Jonathan" pollen affected the fruit (a) by changing the color of the skin, (b) by causing the hybrid segments to grow longer and narrower, thus approximating nearer to the "Jonathan" form, and (c) by changing the taste of the flesh.—*Charles E. Bessey.*

Ruppia maritima L. in Nebraska.—This maritime plant has lately been brought to me from a pond near one of the many salt springs which occur in the vicinity of Lincoln. The species is not recorded in the catalogues of the Western State floras, viz., Minnesota (Upham), Iowa (Arthur), Missouri (Tracy), Kansas (Carruth); nor does it occur in the East, away from the seaside, with but a single exception. It is not found in the flora of In-

diana (Coulter and Barnes), Cincinnati (James), Michigan (Wheeler and Smith), Ohio (Beardslee) Buffalo (Day), Cayuga, N. Y. (Dudley), nor even of Washington, D. C. (Ward). It was discovered many years ago in Oneida county, N. Y., by Paine, who says of it: "This plant and its companion [*Naias major*] are new to the interior, having been known hitherto as exclusively maritime" (Eighteenth Ann. Rep. of the Regents of the Univ. of the State of New York on the State Cabinet of Nat. Hist., p. 133).

In Frank Tweedy's "Flora of the Yellowstone National Park," *Ruppia maritima* is said to be "common in the sluggish streams and water-holes of the hot-spring and geyser areas" (p. 66), and elsewhere (p. 20) the statement is made that it "has been observed in situations where the water had a temperature of 90° Fahrenheit."

The occurrence of this little plant in these widely separated localities is, to say the least, very interesting. From the seacoast to the Oneida county, N. Y., station is fully 150 miles, thence to the Nebraska station is 1100 miles, and from the latter point to the National park is 700 miles. The distance from the Nebraska station to the Gulf of Mexico is about 800 miles.— *Charles E. Bessey.*

THE ROUGHNESS OF CERTAIN UREDOSPORES.—Recently while examining the uredospores of *Puccinia coronata*, a common rust of the oat, a student in my laboratory complained of the difficulty he had in making out the prickly (*stachlig*) surface of the spore-wall. The spores had been mounted in water in the usual way, and it was with the utmost difficulty that any roughness of the surface could be made out, and when made out it was so faint as to warrant the remark that "a character so difficult to be observed and so likely to be overlooked should not be made use of in descriptions." The spores, in fact, appeared in most positions to be perfectly smooth. The suggestion was made to examine them *mounted dry*, when lo! the prickles appeared with the greatest distinctness. This hint may be worth remembering in much of our work in botanical laboratories. — *Charles E. Bessey.*

ANOTHER "TUMBLE-WEED."—While riding through Phelps and Kearney counties, in South-central Nebraska, my attention was called to great masses of some much-branched, white-woolly plant which occupied the ditches by the side of the railway. Its appearance was so odd and so different from anything I had ever seen that I could not conceive what it could be. A fortunate stop of the train outside the limits of a town allowed me to secure specimens, which upon examination proved to be *Psoralea tenuiflora* Pursh. The leaves had fallen and the naked branches, in drying, had diverged still more than in life, giving to the plant

an appearance quite different from that which it bears when growing. The mode of detachment is the usual one of the formation of a joint at one of the lower internodes. In some cases two such joints were observed. The break at the joint is smooth and even, and reminds one of the separation of a leaf from its twig.

It may be well to say that the plant under consideration is densely silky woolly in every part excepting its principal stems. It is certainly not "minutely hoary pubescent when young," as described in the manuals (Gray, Man., p. 129; Coulter, Man., p. 56). On account of the loss of leaves it is impossible to determine whether this may not be the variety *obtusiloba* of Watson (Bib. Index N. A. Bot., p. 255). If so this is a much more northerly range than this variety of the species was supposed to possess. In all cases but one the variety is said to be a native of Texas. Creutzfeldt collected it in "Kansas" in 1853 (Pacific Railroad Report, 2, p. 126), and from the date of its collection (June) it must have been found in Eastern Kansas. Carruth, however, does not record it in his catalogue of Kansas plants (Trans. Kan. Academy of Sciences, Vol. v).—*Charles E. Bessey.*

Botanical News.—The October Journal of Botany contains a paper, by Baron F. von Mueller, on "New Vacciniaceæ from New Guinea." A new genus is described under the name Catanthera. It contains one species, *C. lysipetala* Mueller, which appears to have affinities with Oxycoccus, though strangely it shows relationship alwish the toClethreæ and Pyrolaceæ. It is an epiphyte.——In the same journal James Britten contributes an article on "The nomenclature of some Proteaceæ," in which the question of priority of Salisbury's names in the Proteads and other groups of plants is discussed. He says: "I am of opinion that there was a tacit understanding on the part of the botanical leaders of the period, including Brown, Banks and Smith, that Salisbury's work and names should, as far as possible, be ignored, not only on account of their strong antipathy to the man himself, but also, in Smith's case at least, to the views of classification which Salisbury promulgated;" an outrageous proceeding if true, as it appears to be.——Dr. Newberry gives additional reasons, in the October Torrey Bulletin, for regarding *Pinus monophylla* as but a variety of *P. edulis.* He says: "In the Rocky mountains all are two-leaved; in some arid portions of Nevada the tree is dwarfed to half its normal size, and all the leaves are single. Midway between these districts, in Southern Utah, may be found thousands of trees in which the leaves are half double, half single."—— Dr. Gray's Memorandum of a revision of the N. A. violets, in the Botanical Gazette, indicates certain interesting changes of arrangement and nomenclature. *Viola delphinifolia* Nutt. becomes *V. pedatifera* Don.; *V, cucullata* Ait. var. *palmata* becomes *V. palmata* L., while *V. cucullata* Ait. is considered to be "an entire-leaved variety of the Linnæan *V. palmata.*" The suggestion that

V. pedatifida Don. is "probably only a marked geographical variety of that species [*V. palmata* L.] with all the leaves finely dissected," is worthy of further attention. In the Mississippi valley, where the three forms all grow, often quite near one another, their relations could be well expressed by considering *V. pedatifera* one extreme and *V. cucullata* the other, with *V. palmata* as an intermediate form. However, it will not do to consider the intermediate form, which is far less common than the others, as the type of the species. It is simply an intermediate form, and not a very constant one either.——L. H. Bailey's Preliminary synopsis of N. A. Carices (Proc. Am. Ac. Arts and Sciences) came to hand late in October. It contains notices of 289 species including, in addition to the strictly North American species, those of Mexico, Central America and Greenland.

ENTOMOLOGY.

A Remarkable Case of Longevity in a Longicorn Beetle (Eburia quadrigeminata).—On the 11th of July, 1886, I caught at sugar, which had been placed upon apple trees for the purpose of attracting moths, a light brown long-horned beetle, marked with ivory yellow spots on the elytra. My attention was particularly attracted at this time to the insect on account of a peculiar creaking sound which it began as soon as I picked it up. I had no difficulty in finding that the sound was produced by the rubbing of the posterior margin of the prothorax upon the anterior margin of the mesothorax. The same sound could be made after the insect was dead, by working backward and forward its head and prothorax. Several days after this occurrence I captured a specimen, similar to the first, upon the clothes of a friend, but it disappeared before I reached home. On the 17th of July I found a third specimen on a tree but a few feet distant from that upon which I discovered the first specimen; this individual was also evidently attracted by the sugar. Five days later, July 22, 1886, another specimen came into my posession under much more remarkable circumstances. Dr. Boyd, of Dublin, Wayne county, Ind., called my attention as I was walking along the street, and at once proceeded to remove two small corks with which he had closed two openings in the door-sill of his office. He then requested me to explain what had made the tunnels that evidently extended some distance into the sill. In reply to my questions, he stated that his attention had been called to the freshly made openings early in the morning; at that time the holes were much smaller, and were ragged around the edges. These rough edges he had smoothed with a knife so he could stop them tightly with corks. A short time after he made the discovery mentioned, his attention was attracted by a buzzing noise which came from one of the tunnels. This he put an end to by pouring chloroform into the opening, and then plugging it up with a cork. There had

been no sound of life from the other tunnel, but he had closed it in the same manner. Upon hearing this I removed the cork from the tunnel where the sound had been heard, and in a moment dragged out by its antennæ a beetle, similar to those whose finding I have already described. This beetle is *Eburia quadrigeminata* Say.

Mr. Thomas, in the "Sixth Report of the Illinois State Entomologist" describes the imago as follows: *Eburia quadrigeminata*, "Body, entirely pale yellowish-brown; antennæ hardly more obviously hairy on the basal joints than on the others; thorax, with two black tubercles above, rather before the middle, placed transversely, and a short spine each side on the middle of the length of the thorax; elytra, rather paler than thorax, each with two double, somewhat elevated, bright-yellow, abbreviated very short lines; the two members of the basal spot equal, the other spot is placed on the *middle*, the inner member is shorter than the exterior one; tip, two spined, the exterior spine the longest; intermediate and posterior thighs, two spined at tip, the inner spine rather longest." Mr. Thomas also states that the insect is from three-fourths to an inch in length, and that its larva lives and bores in the honey locust (*Gleditschia triacanthus* Linn), and from this fact it gets its name of the honey locust borer.

A closer examination of the tunnels in Dr. Boyd's doorstep showed that the external openings were in the middle of the length and breadth of an ash door-sill and about four inches distant from each other. The size of the tunnels increased rapidly within until the diameter was three or more times as great as at the exit. They extended downward and backward respectively three and four inches. The sill was of painted ash and it, as well as the whole building, rested directly upon a solid brick foundation. After having completed the above observations, I did not hesitate long in coming to the conclusion that the eggs which had produced this beetle and its fellow, that had made good its escape, were laid in the green wood in the tree. In response to my questions, Dr. Boyd made the statement that the building was erected in the Spring of 1867. This would make these insects not less than nineteen, and probably twenty or more, years old, since the timber was dry when put into the house. Upon investigation I find that Professor Packard in his "Insects Injurious to Forest and Shade Trees," makes no mention of this beetle, but that he has recorded two cases of unusual longevity in beetles which will be of interest in this connection. In both instances these beetles have belonged to the family Cerambycidæ or longicorns. The first mentioned case was that of a specimen of *Monohammus confusor* Kirby, the common longicorn pine-borer, which Mr. A. C. Goodell, of Salem, Mass., presented to the Peabody Academy of Science. Mr. Goodell took the insect from a bureau that had been in the house for fifteen years and was new when bought.

An account of the other case I give in the words of Dr. Fitch: "The wood of the apple tree was formerly highly valued for cabinet work in this country. In 1786 a son of General Isaac Putman, residing in Williamstown, Mass., had a table made from one of his apple trees. Many years afterwards the gnawing of an insect was heard in one of the leaves of this table, which noise continued for a year or two, when a large long-horned beetle made its exit therefrom. Subsequently the same noise was heard again and another insect, and afterwards a third, all of the same kind, issued from this table-leaf; the first one coming out twenty and the last one twenty-eight years after the trunk was cut down." The proof of the identity of these beetles is not complete, but Professor Packard thinks they were *Cerasphorus balteatus*.

I find that *Eburia quadrigeminata* is not given in Hubbard and Schwarz's "List of Coleoptera found in the Lake Superior region," nor in the "Contribution to a list of Celeoptera of the Lower Peninsula of Michigan," by the same authors. But in Schwarz's "List of species" of Coleoptera found in Florida, *Eburia quadrigeminata* is mentioned as being "not rare on sugared trees in June." It is not given in LeConte's "List of species of Eastern New Mexico," but it is mentioned in his "List of species of Kansas and Nebraska." In his "New species of North American Coleoptera," he refers to it as "the ordinary *quadrigeminata* of the Southern States and the Mississippi valley." Thus, while it is a common enough insect over a large territory, no other case of its remarkable longevity seems to have been recorded. On comparing it with the other specimens in my collection, the only decided points of difference are the smaller size of the lateral spines of the prothorax and the terminal spines of the elytra; and the longer antennæ which, not exceeding the length of the body in the other specimens, are in this one one and a-half times as long.—*Jerome M'Neil, Indiana University, Oct. 26, 1886.*

ZOOLOGY.[1]

LEPTODORA IN AMERICA.—It may interest those of your readers who collect fresh-water Entomostraca to know that perhaps the most elegant and remarkable of that interesting group, *Leptodora hyalina*, Lillj., is much more abundant and easily obtainable than is implied by a note on page 896 of your last issue. First dredged by Professor S. I. Smith, in Lake Superior, in 1871, it was next found by me in June, 1877, in the Illinois river at Peoria, as reported in 1878, in Bull. 2, Vol. 1, of the Illinois State Laboratory of National History, p. 88. In the same bulletin I recorded its occurrence in the food of *Dorysoma cepedianum*, *Polyodon folium*, and *Hyodon tergisus*, all from the Illinois river. In our Bull. 3,

[1] Invertebrata edited by J. S. KINGSLEY, Sc.D., Malden, Mass.

published in 1880, it is reported as eaten by young *Morone interrupta* and *Micropterus pallidus*, and again by Dorysoma. In the AMERICAN NATURALIST for August, 1882, it is further reported from both ends of Lake Michigan and from numerous small lakes—one only half a mile wide and not over twenty feet deep. In this lake, I remember, it was rather abundant. In Cedar lake, in Northern Illinois, we took it at night with Corethra larvæ, but we made our most notable haul of this species in Mendola lake, at Madison, Winconsin, where we captured hundreds in the towing net on a bright summer day in 1885. It may be expectingly sought wherever, in permanent and rather deep water, sufficient numbers of the smaller soft-bodied Entomostraca occur to give it a fair chance for prey. It is not a swift swimmer, and its food must be abundant.—*S. A. Forbes.*

BLOOD OF INVERTEBRATES.—Dr. Howell, in Johns Hopkins "Studies," describes the blood of the king-crab, soft-shell crab, and a species of holothurian. In Limulus the blood is alkaline, quickly coagulating. It contains fine albumens which coagulate at different temperatures but which all belong to the globulin group. They resemble but are not identical with paraglobulin. Coagulation in the blood of Limulus results by the union of the corpuscles, and the existence of a coagulative ferment has not yet been proved. The fibrin is much like that of mammals in its solubility. Hæmocyanin certainly contains copper. In Neptunus (= Callinectes), the blood is alkaline but coagulates less quickly than that of Limulus. It contains two albumens to be classed among the globulins, and the coagulation is more complete than in the king-crab. The fibrin is very different from that of Limulus, and of it Dr. Howell says: "The difference seems to me to be too wide to suppose any close relationship between the two forms, especially as they have the same general environments; but until a series of similar observations is made on the scorpion or some arachnid, we will not have sufficient evidence to make any just inferences with regard to the relationship of these forms—that is, from the standpoint here assumed." In the holothurian, which was identified as *Thyonella gemmata*, two kinds of corpuscles were recognized, a red, hæmoglobin-bearing nucleated oval form and a spherical white nucleated form Coagulation was occasioned by the fusion of the white corpuscles, the red not taking part in the formation of a coagulum except as they were entangled in the meshes of the other.

In another article in the same publication Dr. Howell notices the existence of hæmoglobin in this holothurian, the second discovery of this element of the blood in any echinoderm. It coagulates at a lower temperature (56°–60° C.) than that of vertebrates, and is precipitated by a one per cent solution of acetic acid. Foettinger's observations on the existence of hæmoglobin

in the aquiferous system of Ophiactis (Bull. Acad. Roy. Belgique, II, xlix, p. 402, 1880) appear to have escaped Dr. Horrell's notice.

THE BYSSAL ORGAN IN LEMELLIBRANCHS.[1]—The first portion of Dr. Barrois' article is a very full description of the byssal organs or its remains in forms from almost every family, twenty-one in all, and in forty-nine species of lamellibranchs. There is also a historical résumé of the subject, description of additional glands, and a discussion of the homologous organs in gasteropods.

In *Cardium edule* the organ is described in full and others are compared with it. Its parts are: 1. "The cavity of the byssus," a large space in the center of the keel of the hatchet-shaped foot. 2. "*The canal* of the byssus," opening on the surface by a pore. 3. "The byssus," a hyaline thread running out from the cavity through the canal. 4. "Byssal glands," glandular cells lying below the epithelium and opening separately into the cavity. 5. "The groove" running forward from the canal along the margin of the foot to the anterior end. 6. "Glandular cells of the groove" opening into it among the epithelium cells. The epithelium is everywhere perfectly continuous and in the cavity is thrown into numerous lamellar folds.

Various departures from the plan are described and figured; there may be no functional byssus but the other parts may all be present, or the groove, or the glands, or even the cavity may be wanting, or there may be in the adult no trace of any of the organs. In the same family or even genus wide variations may occur. Thus *Tapes virginea* has no functional byssus, the cavity, glands and lamellæ are present, while in *Venus rudis* and others of the family no trace of the apparatus remains. In *Anomia ephippium* the ossicle by which the animal is attached is a true byssus, formed in a cavity lined with lamellæ, a precisely similar one being present in the foot of *Arca tetragona*. The anomalies of its relation to the parts of the body are explained by the lateral attachment of the creature. The "*cornet*" of Anomia, with its groove leading to the byssal cavity, is similar to the muciparous gland on the anterior part of the foot of *Pecten maximus*. In Unio and Anodonta a cavity in the keel of the foot is the only remains of the byssal organ in the adult. This, doubtless the water pore of Kollmann, Griesback and others, is lined with continuous epithelium. It is to be regretted that lack of material has prevented research into the embryonic condition of many of the retrograde forms.

Barrois also describes as characteristic of the lamellibranchs special muciparous glands in the anterior portion of the foot; these in some cases line the inside of a cavity, *e. g.*, *Pecten maximus*, in other cases the organ being everted they line the

[1] Les Glandes du Pied et les Pores Aquiferes chez les Lamellibranches—Par le Dr. Ih. Barrois, Lille, 1885, pp. 160, pl. x.

outer surface under the epithelium of a pedunculated club-shaped body *e. g.*, *Lucina lactea.* The view that the byssus of the lamellibranchs is homologous with the gastropod operculum is rejected on anatomical and histological grounds, and the muciparous byssiparous glands are thought to correspond with the "Lippen-drüsen" and "Fusshöhledrüsen" of Carriere, the one upon the fore-end of the gastropod foot, the other upon the creeping surface.

The second portion of the work is a full historical and critical review of the "water-pore" controversy. No new observations of importance are recorded and the position maintained by the writer is the same as already represented in this journal (see Vol. III, p. 130).—*Henry Leslie Osborn, Purdue Univ., Lafayette, Ind.*

ON THE CLASS PODOSTOMATA, A GROUP EMBRACING THE MEROSTOMATA AND TRILOBITES.—In a paper read before the National Acad. of Sciences we have endeavored, by giving the history of the Xiphosura, Pœcilopoda and Gigantostraca, to show that while the name Xiphosura should be retained for the suborder of which Limulus is the type, the names *Pœcilopoda* and *Gigantostraca* have been applied in such different senses, that they can not well be retained for the Merostomata and Trilobita taken together in the sense we advocate. We have therefore proposed the term *Podostomata* for this class of Arthropoda. It is derived from *πούς, ποδός*, foot; and *στόμα*, mouth, in allusion to the feet-like or ambulatory nature of the cephalic appendages which surround the mouth in a manner characteristic of the group.

The class Podostomata may be defined as a group of marine arthropods in which the cephalic (Limulus) or cephalothoracic (trilobites) appendages are in the form of legs, *i. e.*, ambulatory appendages, usually ending in forceps or larger claws (chelæ), which in the sole living representative of the class are arranged in an incomplete circle around the mouth; the basal joint of each leg is spiny, so as to aid in the retention and partial mastication of the food. No functional antennæ, mandibles or maxillæ. Eyes both compound and simple. Respiration by branchiæ attached to the abdominal appendages which are broad and lamellate in Merostomata, and cylindrical with narrow gills in Trilobita. The brain supplying nerves to the eyes alone; the nerves to the cephalic or cephalothoracic appendages originating from an œsophageal ring; the ventral cord ensheathed by a ventral arterial system more perfectly developed than in insects or scorpions; coxal glands highly developed; with no external opening in the adult. The class differs from the Arachnida, among other characters, in having no functional cheliceres ("mandibles") or pedipalps ("maxillae"); in the cephalic appendages either ending in larger claws or forceps, or in being simple, the terminal joint not bearing a pair of minute claws or ungues like those of Arach-

nida and Insecta, enabling their possessors to climb as well as walk. Podostomata have no urinary tubes. Limulus undergoes a slight metamorphosis, while in trilobites the adult differs from the larva in having a greater number of thoracic segments.

From the Crustacea the Podostomata differ in the lack of functional antennæ, and mouth-parts; in the compound eyes having no rods or cones, in the brain innervating the eyes (compound and simple) alone; in the shape of the head and pygidium or abdominal shield, and in the arterial coat enveloping the central nervous cord.

The Podostomata are divided into two orders:

I. *Merostomata*, with three suborders: { *Xiphosura*, *Synziphosura*. *Eurypterida*.

II. *Trilobita*.

—*A. S. Packard.*

Oyster Culture.—Dr. J. A. Ryder has a paper on this subject in the Report of the U. S. Fish Commission, detailing the construction of apparatus for the artificial culture of oysters which, from a theoretical standpoint, certainly seems practical. His plans have been outlined in this magazine, and hence need not be repeated. One of the points brought out is that Lankester's beautifully illustrated paper on green oysters (Quart. J. M. S. xxvi, pp. 71–94, pl. vii, 1885) contains hardly an addition to our knowledge of this phenomenon, besides the conferring of the name marennin on the coloring matter absorbed. Almost every point made was previously published by Puységur, Descaine or Ryder from two to five years before.

Echinoderm Development.—Fewkes has some observations on the development of Ophiopholis and Echinarachnius. He shows that in the former genus the endoderm arises by an invagination, but he cannot state the relations the blastopore bears to either mouth or anus of the pluteus. The mesoderm arises symmetrically either side the blastopore and apparently is of the nature of mesenchym, though not so stated. Nothing is given concerning the development of the mesothelial tissues. Apostolides who has previously studied the development of Ophiurans comes in for some apparently merited criticisms. In the sand-dollar, Echinarachnius, the early development is much the same. The pluteus is compared with that of Strongylocentrotus, from which it differs in the presence of large pigment-spots on each arm and the absence of "ciliated epaulettes." The whole of the pluteus is absorbed in the young sand-dollar, which has a very different appearance from the adult. The development presents but slight differences from other echinoderms.

THE BRAZZA EXHIBITION AT PARIS.—An exhibition of the contents of eighty boxes brought from the French possessions on the Congo, by M. de Brazza, was opened June 30, of this year, in the orangery of the museum. Two species of chimpanzee, *Troglodytes tschego* and *T. aubryi; Colobus guereza* (not before known) from West Africa; a new species of Colobus *(C. thollous* M. Edw.); a new Cercopithecus *(C. brazzæ*, M. Edw.); *Cercocebus agilis* M. E. (nov. sp.), and a single form of lemur, *Galago demidoffi*, are among the mammals of the region. *Hypsignathus monstrosus* (the title of a very large and hideous bat); and *Anomalurus erythronotus* are also curiosities. Antelopes do not abound on the Congo, but *Tragelaphus gratus* inhabits the marshes which border the river, and *A. maxwelli* also occurs. The buffalo is *Bubalus equinoxialis*, smaller than *B. caffer*, but equally redoubtable. Birds of prey were well represented in the collection, which contained also numerous cuckoos, among which *Centropus savorgnani* and *Coccystes brazzæ* (Oustalet) are new to science. There was also a new swallow *(Phedina brazzæ)*. Most groups of African birds were well represented, but novelties do not appear to abound. Among the snakes were a new Heterolepis and a Microsoma. The collection of fishes added a Polypterus *(P. retropinnis* L. Vail.) of small size; and contained no less than twenty-three species of Characinidæ, several of which are new. It is a surprise to find this family, the headquarters of which is in South America, so abundant in West Africa. *Hydrocyon forskalii* reaches a length of two meters. Cyprinidæ were less numerous, among them were *Opsaridium fasciatum* L. Vail., resembling a sardine, and *Labeo coubie*, which grows to the length of a meter. Among fourteen species of Siluridæ *Doumea scaphyrhynchura* is new. No less than thirteen species of Mormyridae were represented. Acanthopteri are rare in the Congo region, but a few Chromidæ occur, among them *Acanthochromis regularis* and *A. seminudus* L. Vail. A species of flying fish, somewhat different from *Pantodon bucholzi* Peters, was among the curiosities. The fish are greatly infested with parasites.

Among the fresh water Crustacea M. Milne-Edwards has found five new species of Thelphusidæ.

Among insects the Coleoptera, and especially the Cetoniadæ, were best represented. Of the few molluscan specimens two species of Pharaonia seem to be new. There were many new species and some new genera of plants; while the ethnographical collection contained a very large number of objects, fetishes, pottery, pipes, iron and copper implements, articles in wood and ivory, etc. Two human skulls from Rio San Benito are remarkably dolichocephalic.

ZOOLOGICAL NEWS.—*Protozoa.*—Lankester reports in Nature (Sept. 2) the rediscovery of Archer's Chlamydomyxa which has

not been seen since its original description twelve years ago. He found it encysted in Sphagnum, and after a short delay it threw out its protoplasmic filaments and presented an appearance which leads Professor Lankester "to admit that it is *less* closely related to Cienkowski's Labyrinthula than I had previously supposed."——*Astrorhiza angulosa* a foraminifer dredged by the *Challenger* in a depth of one thousand fathoms, seventy miles east of the Açores, has been reported from the older Tertiary rocks of Victoria, Australia.

Sponges.—Dr. R. von Lendenfeld described the nervous system of several sponges at the recent meeting of the British Association for the advancement of Science. He called attention to the fact that in the sponges the most important organs are mesodermal (this is the case with the nerve cells) while in the Cœlenterates proper they are ecto- or ento-dermal. On the basis of this he proposes to divide the cœlenterates of Claus into Cœlenterata-Mesodermalia or sponges and Cœlenterata-Epithelaria or cœlenterates proper. It would seem as if these facts were an argument in favor of the view that the cœlenterates of Claus was not a natural group, a view for which there are many other reasons for adopting.

Cœlenterates.—Haddon states that his species *Halcampa andresii* is not valid but must stand as a synonym of *H. chrysanthellum* (Peach) Dana.——G. Y. Dixon gives some notes on *Edwardsia timida* with a colored plate showing the entire animal and some of the details. He regards *E. harasii* and *E. timida* as synonymous. His paper and that of Haddon are in Vol. v. of the Proceedings of the Royal Dublin Society.——At the meeting of the British Association, Dr. von Lendenfeld described the development of *Phyllorhiza punctata* of Australia. The ephyra has eight marginal sense bodies; at the next stage it has twenty-four, then sixteen, while the adult has only eight.——The same author further stated that *Crambessa masaica* goes up the Australian rivers at the breeding season to deposit its young, just as does the salmon. This species has remarkably changed its color at Port Jackson within fifty years. At that time it was blue, but now is superseded by a brown variety. At Port Phillip, only a few hundred miles to the south, the blue variety still persists.——Dr. C. A. MacMunn has a paper on the chromatology of certain Actinias in the 176th volume of the Philosophical Transactions. The observations were made by means of the micro-spectroscope and show the existence of a respiratory coloring matter allied to hæmogolbin and of a biliverdin which is probably concerned in excretion. Concerning the "yellow cells" the author states that the fact that they appear to cause a suppression of those pigments which in other Actineæ appear to discharge a respiratory function is an argument in favor of their being regarded as symbiotic algæ. Moseley's

actinochrome is regarded as decorative and is always confined to the tentacles. Another pigment is found in the eye spots which has a spectrum bearing some resemblance to that of a red pigment found in the eyes of certain insects.——Hickson has obtained the early stages of Tubipora. It is regularly holoblastic and there is an invaginate gastrula. He has also made some observations on a species of Clavularia from Celebes which go to show that this genus is closely allied to the fossil Syringopora, thus adding to the evidence that the latter is an Alcyonarian —— The absence of special buds or gonophores to contain the sexual products of Hydra is by Professor A. M. Marshall regarded as a highly modified character due to the influence of fresh water. In Cordylophora, the other fresh-water genus, the ova develop in a zone of germination round the necks of the zoöids, before either the gonophore or the branch on which it will be borne is developed. Afterwards the ova migrate into the gonophore. Evidently Cordylophora is in course of suffering a transformation into sexual conditions like those of Hydra. The normal Hydroida are bisexual and develop Medusæ.

Echinoderms.—According to recent researches by R. Koehler, the circulatory system of the ophiurans is much like that of the Echinoidea, the same relations being found in the madreporic gland, the rings around the mouth and the branches arising from them.

Worms.—A. Giard described a new Rhabdocœle, *Fecampia erythrocephala*, at the meeting of the Academy of Sciences of Paris, September 13. It is parasitic and forms a cocoon. Attention was called to the fact that it resembles a parasite found by Lang in the foot of the mollusk, Tethys, which will probably also be found to form a cocoon.——Professor W. C. McIntosh, in Nature, of September 16, thinks that Phoronis and Actinotrocha are more abundant on the British coasts than the records would indicate.——G. Fritsch, in the Sitzungsberichte of the Berlin Academy (Jan. 28, 1886, p. 99), describes and figures the parasites of the electrical cat-fish Malapterurus. The novelties are *Corallobothrium solidum*, nov. gen. et. sp., *Tænia malapteruri* and a nematode, *Trichosomum papillosum*.——Schoyen describes, in the Christiania Forhandlingar for 1885, a new species of trematode, *Tylenchus hordei*, which forms galls on the roots of grass in which the eggs are deposited——Dieffenbach, has an anatomical and systematical paper on Oligochæte worms in the Bericht of the Oberhessichen Gesellschaft for 1886. He describes the anatomy of *Lumbriculus variegatus* and of the Tubificidæ, and has notes upon the Naids. A new genus, Pseudolumbriculus, and two new species, *Ps. claparedianus* and *Pachydrilus lumosus* are described. ——Sluiter has a paper on the Gephyreans of the Malay archipelago in the Tijdschrift of the Dutch East India Society, Vol. XIV (1886). The paper enumerates thirty species as known from

that region, of which thirteen are now described for the first time. Some anatomical and histological notes are given.——Bell calls attention to the fact that in the land planarians the form of the head is very variable and cannot be used, as is often done, as a basis of generic division. He also states that Bipalium is sensitive to light, and if the light be too strong the specimen is killed.——Collet describes (Proc. Zool. Socy., 1886) a new species of Echinorhynchus (*E. ruber*) from Rudolphi's rorqual (*Balænoptera borealis*). He suggests that its early stages may be passed in *Euphausia inermis*, one of the Thysanopoda.

Mollusks.—Mr. George W. Shrubsole (Journal of Conchology, v, 66, 1886) has some notes on erosion of fresh-water shells. He noticed that in specimens of Planorbis living in the Trent canal, the shell was entire, but after being kept for three months in water from the River Dee considerable erosion had taken place. This suggested that the character of the water might have a prominent place in the erosion, and analysis showed that the water of the Trent canal contained about three times as much lime in solution as that from the River Dee. The fact that erosion did not set in at once is explained by the existence of the epidermis.——Mr. Edgar A. Smith states that the genera Turtonia and Cyanium are distinct, the latter genus possessing an internal cartilage. Jeffreys had previously united them.

Brachiopods.—Miss Agnes Crane describes (Proc. Zool. Soc., London, 1886) a new species of brachiopod (*Atretia frazieri*) from Port Stephens, New South Wales.

Arachnida.—G. Saint-Remy, at the meeting of the Paris Academy, Sept. 20, presented the results of his studies of the brain of the spider based upon the genera Tegenaria, Epeira and Phalangium. The brains of these forms have the same general plan of organization as that of the scorpion, on which a report had previously been made.——Adolph Horn describes the poison apparatus of twenty-one species of spiders in the Bericht of the Oberhessichen Gesellschaft for 1886. The poison glands consist of two elongate cylindrical cœcal sacs enveloped in connective tissue and spirally arranged muscles. Their ducts terminate near the tips of the mandibles.——Grassi describes a new arachnid in the Bulletin of the Italian Entomological Society (Vol. XVII, 1886) under the name *Kœnenia mirabilis*. He regards it as the type of a new order, Microthelyphonida. In general appearance the form stands nearest the thelyphonids, as the name indicates. Grassi points out twenty-four points in which it differs from the whip scorpions.

Ascidians.—Sluiter describes fourteen new species of ascidians from Billiton island. For one of them a new genus, Styeloides, is proposed.

Crustacea.—Professor C. L. Herrick gives (Bull. Denison Univ.)

an account of various stages in the development and points in the morphology of *Limnetis gouldii* and *Chirocephalus holmani*, two phyllopodous Crustacea. He also describes *Nyocryptus setifer*, a mud-living cladocerous crustacean.——Packard describes (Proc. Philos. Soc., XXIII, 380) the feet in Cryptozoe, a new genus of fossil Phyllocaridan crustacean, allied to Nebalia. The figures are too poor to show any detail, but the feet, according to the text, are much like those of Nebalia. Nothing had been known of the nature of the feet in the fossil forms before.

Vertebrates.—The "Segmental value of the cranial nerves" is treated of histologically and argumentatively by Professor A. Milnes Marshall, in Vol. I of Studies from the Biol. Laboratories of Owens College. The following table expresses the results arrived at:

Segment.	*Nerve.*	*Visceral cleft.*	*Visceral arch.*
1. Preoral	I. Olfactory	Olfactory	
2. "	III. Oculo-motor IV. Trochlear	Lachrymal	
3. Oral	V. Trigeminal	Buccal	Maxillary.
4. Postoral	VII. Facial VI. Abducent	Spiracular or hyomandibular	Mandibular. Hyoid.
5. "	IX. Glossopharyngeal	1st branchial	1st Branchial.
6. "	X. Vagus, 1st branch	2d "	2d "
7. "	" 2d "	3d "	3d "
8. "	" 3d "	4th "	4th "
9. "	" 4th "	5th "	5th "
10. "	" 5th "	6th "	6th "
11. "	" 6th "	7th "	

The vagus supplies the six posterior branchial clefts in the Marsipobranchii and Notidanus, and is therefore considered equivalent to *at least* six segmental nerves. The XIth, or spinal accessory, and the XIIth, or hypoglossal nerves are not constant as cranial nerves throughout the vertebrate series, and are not dealt with in this paper.——By a study of the branchial sense-organs of Ichthyopsida, Dr. J. Beard endeavors to work out the same problem. He also finds eleven head-segments in sharks, but they differ from those of Professor Marshall, since the radix longa of the ciliary ganglion and the auditory are ranked as segmental nerves, the facial is allowed two segments, and the vagus four only.——To the first volume of Studies from the Biological Laboratories of Owens College, Professor A. Milnes Marshall contributes some observations on the cranial nerves of Scyllium. He does not attempt to determine the homologies between the nerves of Scyllium and those of higher vertebrates, preferring to wait for more

positive evidence.——Those interested in nervous anatomy may find an exhaustive article on the central nervous system of the baleen whales, by G. A. Guldberg, in the Forhandlingar of the Scientific Society of Christiania for 1885, published during the present year.——G. Fritsch describes the histology of the skin and the lateral-line organ of the electric cat-fish in the Sitzungsberichte of the Berlin Academy of Science for April, 1886.

ANTHROPOLOGY.[1]

AUSTRALIAN MEDICINE MEN.—In one respect it is unfortunate that the sorcerers among savages should be called "medicine men," they are not merely practitioners of medicine. Furthermore, all savage tribes have arrived at a certain stage of empirical medicine and know the healing and poisoning qualities of certain minerals and plants. The dawn of medicine, as of all else which we believe and practice, was in the day of the primitive savage.

We are concerned here with the doctor or medicine man, who, in Australia, Africa or America, relies upon his influence and power over the spirit world to work cure or to save life.

In our own country patient study is revealing much concerning this important class. Major Powell and several other gentlemen of the Bureau of Ethnology have paid personal attention to them. We are indebted to the London Anthropological Institute for the publication of important papers upon the "Blackfellow Doctors" of Australia, notably that of Mr. A. W. Howitt, in Vol. XVI, pp. 23–58. The men and women who in lower tribes stand for the clergy as distinguished from the laity, or uninitiated, are variously styled doctors, wizards or witches, sorcerers, seers or prophets, mediums, soothsayers, necromancers, rain-makers (better weather-makers), magicians, augurs, fortune-tellers, enchanters, priests, personators, diviners, etc.

Now these can readibly be divided into two classes or functions, viz., those who see into, understand and reveal the spirit world; and those who have more or less control over it, compelling it to do their bidding.

The medicine man, doctor, sorcerer, wizard, fetish man are all of the latter class. Whatever disease and death may be, whether merely the person or spirit of some noxious thing or an independently existing spirit, one of the powerful charmers can induce or compel it to do his bidding, either by direct command or by some diplomatic action called magic.

In the collection of material for a scientific investigation of this class of persons, I have found it convenient to adopt the following questions:

1. What are the actors called and what social rank do they hold.
2. By what rites or initiations do they attain to the privileges of their class.

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

3. What do they profess to do? What are they believed to be able to do? That is, to which class above named do they claim to belong?
4. What do they actually perform? What is their mode of treatment? Do they sing, dance, go into ecstasy, suck the wound, spit out the disease in the form of a bone, stone, &c.? That is, not what they claim to do, but what do they actually? What dress, paraphernalia, implements and dramatic performances do they resort to? What fees do they charge?
5. What is the area of their operation, both in the spirit and in the mundane world? Some cause, others cure disease. Some have influence in one sphere, others in other spheres of spirits. Again, some operate on the sick, others on the conjured, lovers, lost cattle, epilepsy, etc.
6. Folk-lore, beliefs and customs of the folk in view of the foregoing subjects of inquiry.

Thanks to the efforts of Mr. Howitt and others we are able to answer some of these questions concerning the Australians. "I have adopted," says this author, "the term medicine men as a convenient title for this memoir, but the term 'doctor' or 'blackfellow doctor' is always used in Australia for those men in a native tribe who profess to have supernatural powers. The doctors are magicians or wizards. I may roughly define doctors as men who profess to extract from the human body foreign substances which, according to aboriginal belief have been placed there by the magic of other doctors, wizards or supernatural beings, such as the *Prewin* of the Kurnai, or *Ngarang* of the Woiworung."

The social relations of these blackfellow doctors to the community varies from tribe to tribe. In some tribes the head man need not be a wizard, but is either a very brave man or a man of influence. Among the Muning tribe the *gommera* is both head man and sorcerer combined. He is the *biambian*, or master of his local group. The oldest *gommera* is the *bambian* of the other *gommeras*. He must be gray bearded, speak several dialects and "bring things out of himself."

A vast deal of mystery surrounds the education of the doctors. Mr. Howitt narrates at full length, pp. 49–52, the story of his own initiation told by one of his friends.

As said, the doctor and wizard are associated in function. They profess to project a quartz crystal or black stone against or into their victim or into their own bodies, to cause magical things to enter a victim by burying them in his tracks, and on the other hand to annul the power of these introjections. These same clergy claim to know and to compel or restrain the weather (meteoroscopy or meteorocracy), to fly through the air, to metamorphose themselves into animals, to be invisible and to render persons and things invisible, to talk and associate with ghosts and familiars, to abstract a man's fat, to discover the causes of death, disease or evil fortune, and finally to produce a distant effect upon a person by performing it upon a part of him or something he has touched or held.

There comes out in this study the very best interpretation of

the synecdochical sorcery and medicine. Why should a piece of the man or of something he has touched be burned with the thorn, burr or thing that is to do the fatal action? Why simply to give the spirit of this hurtful thing the scent of the man, just as hunters train young dogs by allowing them to smell a piece of the hide of the animal they wish to be caught.

As to the actual performances, dress and implements of the doctors, Mr. Howitt is very explicit.

All doctors carry rock crystals and use them in their practice. Some diseases, such as rheumatism, are supposed to proceed from rock crystals. Indeed the afflicted can feel the little stones in the affected part. The doctor frequently sucks the part in pain, expelling a foreign body, a mouthful of wind or a quantity of blood. He manipulates and squeezes the patient, singing charms and performing innumerable mysterious actions.

In producing a spell the doctors often fasten the fatal object to the end of a throwing stick with hawk feathers and some human or kangaroo fat, and stick the weapon slanting in the ground before the fire. It falls down. The wizard has meanwhile sung his charms and the spell is completed. Again the pounded flesh of a dead man is mixed with tobacco, or the cones of the *Casuarina quadrivalvis* are thrown into the fire so that their spirits or little seconds may get under his eyelids and produce granulation.

A powerful magical implement is the *yulo*, an implement twelve inches long made of the leg bone of a kangaroo, pointed, having attached to it a long cord of twisted sinews, thirty-six inches long, ending in a loop. It is used by the wizard for binding their victims from whom they wish to take the kidney fat. Watching until the victim sleeps he creeps up, passes the bone under his knees, around his neck and through the looped end of the cord.

It is also pointed at people and is supposed to cause death by entering into them. The wizard was supposed to swing the *yulo* around his head and sling it at his victim.

From Mr. Howitt's language we would suppose they really take the fat from the dead and eat it, and that he really binds his living victim with the *yulo*, or knocks him down with the *brepent*, sits astride his chest, cuts open the right side below the ribs, extracts his fat, brings the cut edges of the wound together, and bites them to make them join so that no scar will be visible.

We will close this note with allusion to the *yenjin*, a song of elopement sung by a class of wizards called *Bunjil yenjin*, whose occupation is to aid in the elopement of young couples. When a young man wanted a girl whom he could not obtain from her parents, he employed one of these professionals. The latter would lie near the camp with the youth and his companions and sing a song, the others joining in the chorus. When he thought his spell strong enough he ceased, and the young folks, *nem. con.* would take to the bush together.

THE ICONOGRAPHIC ENCYCLOPÆDIA.—The second volume of this publication is based on von Eye's Culturgeschichte, but has a chapter on Prehistoric Archæology, by Professor Daniel G. Brinton, which doubles the value of the original work. We have no hesitation in placing this article at the head of all compendiums upon this subject. The method of treatment is historical.

The introductory chapter is devoted to a sketch of the science and the methods and problems which have for the past quarter of a century engaged the minds of archæologists. The characteristics and art productions of the European age of stone in its two periods, the palæolithic and the neolithic; the age of bronze and the age of iron are treated in the first fifty pages.

The prehistoric archæology of the western hemisphere is treated under the following analysis:

I. Palæolithic period.
  1. The Palæolithic period of North America.
  2. The Palæolithic period of South America.
  Concluding remarks on the Palæolithic period.

II. Neolithic period.
  A. Archæology of the United States.
    1. Art in stone.
    2. Pottery.
    3. Bone.
    4. Shell.
    5. Metals.
    6. Other ancient remains.
  B. Archæology of Mexico and Central America.
    1. Art in stone.
    2. Metals.
    3. Pottery.
    4. Bone and Shell.
    5. Paper.
  C. Archæology of the Andean nations.
    1. Art in stone.
    2. Art in bone, shell and wood.
    3. Metals.
    4. Pottery.
    5. Other arts.
  D. Archæology of Southern and Eastern South America and the West Indies.
    1. Art in stone.
    2. Pottery.
    3. Metals, bones and shell.
    General observations on American art.

It is marvelous to see how much Dr. Brinton has crowded into such a small space. No one is expected to say everything in an encyclopædic article. The only improvement we could suggest would have been to give with each paragraph a reference to the most distinguished treatise on that topic. This would have done

little more than to fill out the closing lines, and would have made the paper little longer. It will probably be a long time before any other author half so qualified as Dr. Brinton will try to cover the whole ground of American archæology.

MICROSCOPY.[1]

REVOLVING AUTOMATIC MICROTOME.—The microtome represented in the accompanying cut is the invention of Adam Pfeifer, mechanic and instrument-maker to the Biological Laboratory of the Johns Hopkins University.

The machine is designed to save time and labor in the preparation of series of sections, and to attain at the same time the greatest uniformity in the thickness of the sections.

The mechanism is very simple. The frame (Fig. *B*) contains a horizontal screw beneath the sliding carriage (*C*). The carriage carries the knife (*K*). This carriage is moved forward by turning of screw. Two arms of the frame support the axis (*J*) of the revolving wheel (*E*), to which the imbedded object is attached. The knife (*K*) is clamped in an upright position on the arms rising from the sliding carriage, so that the edge of the knife is in the same horizontal plane with the center of the axis (*J*). Thus, as the sliding carriage is moved by the screw, so the knife is moved to or from the revolving object. The carriage slides by means of grooves on raised tracks of the frame, and is not directly connected with the screw, but is simply pushed by nut (*N*). This arrangement makes it impossible that any slight eccentricity of the screw should cause a jolting of the carriage.

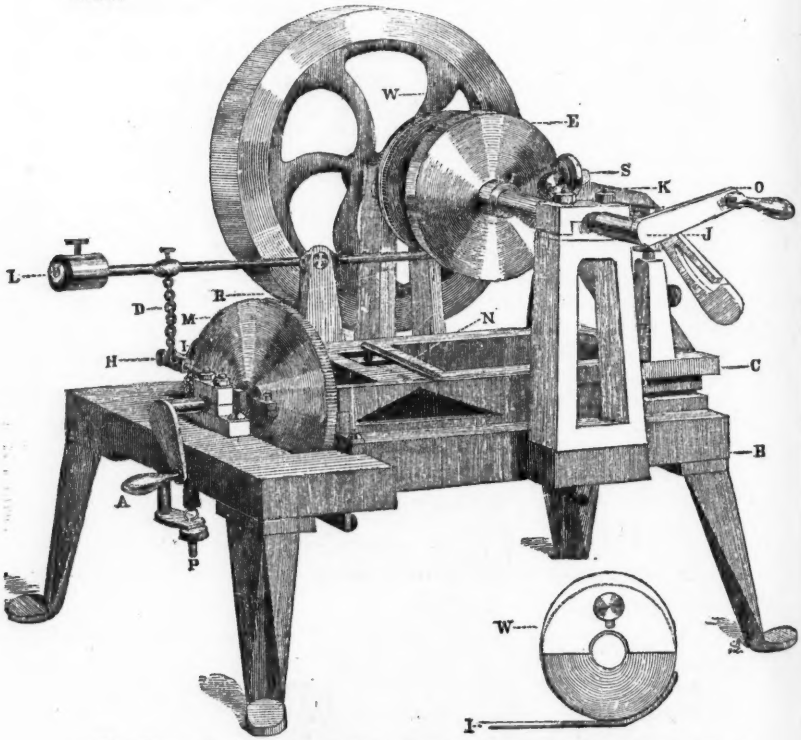
The head of the screw is a solid wheel (*M*) at the end of the frame, and has 250 ratchet-teeth on its circumference. The screw has twenty threads to the inch (= .025^{m}). The knife, therefore, is moved an inch by twenty revolutions of the screw; and as there are 250 teeth to the revolution, each tooth represents $\frac{1}{20 \times 250} = \frac{1}{5000}$ inch (.005^{mm}).

The handle (*O*) turns the axis (*J*), to which is attached the wheel (*E*). This wheel is four inches in diameter, and to it is fastened the clamp which holds the object to be cut. The axis also carries a fly-wheel and an adjustable eccentric wheel (*W*), which is figured apart in a corner of the illustration. This eccentric moves a lever (*L*), the long arm of which is connected with the small chain (*D*). The chain lifts a small lever (*H*), which works by means of a catch (*I*) on the teeth of the screw-head, causing the screw to revolve. The small lever is steadied and pulled back to its place by a spiral spring (*P*), while another spring-catch underneath the frame prevents the ratchet-wheel from turning back. By properly adjusting the eccentric wheel

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoölogy, Cambridge, Mass.

the levers may be made to act so that the catch (*I*) will take any desired number of teeth by every revolution of the object. The knife moves only during that part of the revolution when the object is not in contact with the knife. The ribbon of sections slides downward from the knife and is caught on a piece of paper placed upon the table.

The wheel holding the object, as well as the razor, can be moved so that almost all parts of the edge of the razor can be used.

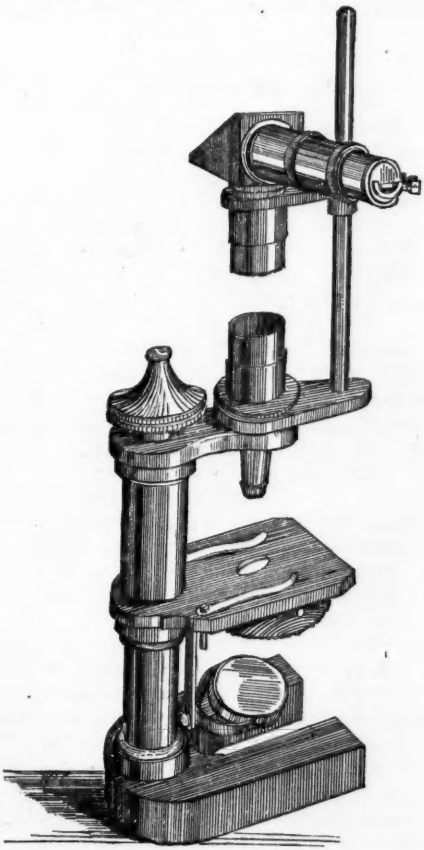


The frame bed of the microtome is made of iron, the screw of steel, and all the rest is brass. Any ordinary microtome knife or razor may be used.

The machine has been in use for a year and gives the greatest satisfaction. It can be used with great rapidity, but so far the best results have been obtained at a rate of not over a hundred sections to the minute. The only possible error in a revolving microtome of this kind is theoretical—namely, that owing to the circular motion of the object, each section is part of a hollow

cylinder. But in reality, with objects of ordinary size, this error is not apparent, and even under a high magnifying power there is no perceptible difference between sections cut by this microtome and those cut by ordinary slide microtomes.

EMBRYOGRAPH FOR USE WITH ZEISS MICROSCOPES.—This piece of apparatus, which is the work of Adam Pfeifer, the instrument-



maker of the Biological Laboratory of the Johns Hopkins University, renders the Zeiss-Oberhausen camera available for drawing objects under very low magnifying powers. It consists, first, of a collar fitted to the arm of the microscope, and furnished with a short draw-tube, which can be placed with the objective either above or below the arm; and second, of a vertical rod, supported

on an arm which is clamped under the collar of the draw-tube, and carries a second movable arm resting in a collar to support the camera. This arm is held in place by a thumb-screw, and it may be set at any point on the vertical rod. When the Zeiss *a.a.* objective is used, and the camera is lowered as much as possible, an image magnified about three diameters is projected on to the paper, and any amplification greater than three diameters may be obtained by varying the height of the camera, and by the use of the higher objectives.

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SCIENTIFIC NEWS.[1]

— One of the most remarkable salt formations in the world is located on the Isle of Petit Anse, Southwestern Louisiana, 125 miles due west from New Orleans. It is owned by the Avery family. This singular salt deposit is sufficiently unknown to bear the light of a more thorough investigation than it has had. The deposit is pure crystal salt. So far as it has been traced, there are 150 acres of unknown depth, explored 140 feet down. The surface of the bed undulates from one foot above to six below tide-level. The earth covering the salt ranges from ten to twenty-three feet in depth, but one hill rises 183 feet above, showing that an after-formation took place. On the top of the salt, beneath the earth, have been found the remains of the mastodon, mammoth sloth, horse (*Equus fraternus*), tusks and bones intermixed with Indian relics such as arrow and spear points, tomahawk heads, paint pots, mortar and pestle and pottery of all kinds. The dip of the salt is eight degrees. There is a deposit of pink sandstone quite decomposed, a coal formation thirteen to seventeen feet thick and seventy-two per cent carbon, the lignite cropping out a hundred feet above the sea. Over the salt come pink and yellow clay beds, then the sandstone and then the clay, each stratum trending towards the north. There are also sulphur springs. The salt is a conglomerate mass of crystallizations, which in the mine look like dark salt, but when exposed to the light are seen to be white. By analyses the salt is $99\frac{88}{100}$ per cent pure; the remaining $\frac{3}{25}$ is made up of sulphate and chloride of calcium. The position of the salt shows it to be older than the coal and sandstone which lie above it, and also the mastodon and contemporary prehistoric mammals. The deposit was discovered in 1862 while a well was being excavated. It was seized by Jefferson Davis and afterward by Admiral Farragut. It is now worked by a New York concern which pays the Averys $5000 per month royalty. To show the value of land here, it may be stated that a single acre, on which grow little peppers, yields a clear profit of $10,000 per year on the well-known Tobasco table sauce.

[1] Edited by WM. HOSEA BALLOU, 265 Broadway, New York.

— Dr. Isaac Lea, the distinguished conchologist of Philadelphia died recently at an advanced age. He was born in Philadelphia, and during his earlier life was engaged in business as a bookseller. His interest is science was however always great, and he retired from business early with a competence, and devoted himself to his favorite pursuit. His specialty was conchology, and in this field his publications, on both recent and extinct forms, are numerous and well known. He was for several years president of the Academy of Natural Sciences of Philadelphia, and was an honorary member of the numerous illustrious societies, including the most important scientific bodies of England, France, Germany, Italy, Switzerland, Austria, Belgium, Greece, India and Russia. He entertained 200 members of the British Association at his Long Branch villa in 1884.

— The "hog mice" referred to by Mr. Aldrich in "A curious superstition," on p. 744 of the present volume, are apparently the shrews, concerning which superstitions of the same character were formerly common in England. References to the belief that these animals would cause injury to the foot of man or beast over which they passed, may be found in Bell's "British Quadrupeds," and White's "Natural History of Selborne," where may also be found some curious remedies for the lameness resulting.— *J. S. K.*

— At the recent meeting of the British Association for the Advancement of Science at Birmingham, the following appropriations for biological research were made: Lymphatic system, £25; Naples zoölogical station, £100; Plymouth biological station, £50; Granton biological station, £75; Zoölogical Record, £100; flora of China, £75; flora and fauna of the Cameroons, £75; Migration of birds, £30; British marine area, £5. The number attending the meeting was about 2500.

— One will have to go far to find a more delicious bit of nonsense than is contained in the following title of an article which appears in one of the scientific journals: "The identification of the British inch as the unit of measure of the Mound-builders of the Ohio valley." The publication committee must have been napping when this article was accepted.

— Dr. Baur, of the Yale College Peabody Museum narrowly escaped serious injury recently by the explosion of a decomposed ostrich egg. The sudden escape of the confined gas knocked him senseless, but as the egg was wrapped in a cloth his eyes happily escaped injury. That the doctor had to submit to a disinfection afterwards will surprise no one.

— The species of tree moss, *Ursea barbata*, grows to a considerable length on the south shore of Lake Superior. Specimens re-

cently added to the collection at the Northwestern University, Evanston, were four feet long. The moss trails from the limbs *a la* the parasitic "Spanish moss" of the South. It is of a beautiful pea-green color.

— The streams penetrating the Gogebic Iron range, near the south shore of Lake Superior, are so black with discoloration from the ore, that fish can not live in them. This is particularly true of the Montreal river, the northern State line between Wisconsin and Michigan.

— Professor Henry L. Osborne, of Lafayette, Indiana, has taken the position of editor of the American Monthly Microscopical Journal, during the absence of Mr. Hitchcock in Japan We look for an improvement in the journal.

— Mr. J. A. McNiel, of Binghampton, N. Y., offers for sale forty pieces of pottery in one-half bbl., seventy-five pieces pottery and fifty stone implements in bbl. These are far above the average in style and desirability.

— The k. k. Naturhistorischen Hof-museum in Vienna has begun the publication of its annals, the first and second numbers of Vol. I having appeared.

— A single gill-net in use among the Apostle islands, in Lake Superior, is three miles long and requires an entire day to empty and set it.

— A portrait of Hermann Schlegel, of Leiden, may be found in the Altenburg Mittheilungen for 1886.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

THE NATIONAL ACADEMY OF SCIENCES held its autumn meeting at Boston, Mass., commencing November 9. The following papers were read:

November 9th:

The solar-Lunar spectrum, by S. P. Langley; A basis of chemistry, by T. Sterry Hunt; On lemurine reversion in human dentition, by E. D. Cope; On .th columella auris of the tailed Batrachia, by E. D. Cope; Change in Mya since the Pliocene, by Edward S. Morse; The Cave Fauna of North America, with remarks on the anatomy and origin of blind forms, by A. S. Packard.

November 10th:

Primitive forms of Cephalopoda, by Alpheus Hyatt; A case of evolution in the migration of forms, by Alpheus Hyatt; Lituites of the limestones of Phillipsburg, Canada, by Alpheus Hyatt; A chart of the stars in the group Præsepe, by C. H. F. Peters; A catalogue of stars from positions in various astronomical periodicals, by C. H. F. Peters; A catalogue of bright lines observed in the atmosphere of β Lyræ, by O. T. Sherman; On the relative motions of the Pleiades group deduced from measurements made with the Königsberg and Yale College heliometers, by W. L. Elkin.

November 11th:

Archæological explorations in the Little Miami valley, Ohio, conducted by F. W. Putnam and C. L. Metz, by F. W. Putnam; Draper memorial photographs, by F. C. Pickering; Some observations with Pritchard's wedge photometer, by C. A. Young; The question of barometer exposure, by C. Abbe; On the construction of new tables of Saturn, by G. W. Hill; On the relation of the Green Mountain rocks to the Taconic, by R. Pumpelly; Hardness and chemical indifference in solids, by T. Sterry Hunt; On wind as a seed-carrier in relation to one of the most difficult problems in geographical distribution, by Alfred Russell Wallace.

The sessions were held in the Institute of Technology. On Wednesday evening, November 10th, the academy was entertained at the house of General Francis Walker, president of the institute.

BIOLOGICAL SOCIETY OF WASHINGTON, Oct. 30, 1886.—Communications: Mr. Wm. H. Seaman, Notes on *Marsilia quadrifolia;* Dr. Theo. Gill, The characteristics of tæniosomous fishes.

Nov. 13.—Communications: Dr. Filip Trybom, of Stockholm, Recent progress in zoölogy in Sweden; Mr. J. W. Chickering, Jr., Travels in Alaska; Mr. Wm. H. Dall, Historical notes on the department of the U. S. National Museum.

NEW YORK ACADEMY OF SCIENCES, Oct. 18, 1886.—The following paper was read: Earthquakes: what is known and believed about them by geologists, by Professor John S. Newberry.

Oct. 25.—The following paper was read: Notes on the geology of Block island and Nantucket, by Mr. F. J. H. Merrill.

Nov. 1.—The subject of earthquakes and volcanic action formed the basis of a discussion, supplementary to the paper of Oct. 18.

Nov. 8.—The following paper was presented: A limit to the height of atmosphere, by Dr. Henry A. Mott.

Nov. 15.—The following paper was presented: Recent investigations on the mitigation of pathogenic Bacteria (with illustrations by the lantern and microscope), by Mr. C. E. Pellew.

Nov. 29.—Professor Albert R. Leeds, of the Stevens Institute of Technology, read his paper on the purification of water supplies, announced for the 22d, and unavoidably postponed.

BOSTON SOCIETY OF NATURAL HISTORY, Oct. 6, 1886.—At the first meeting after the summer vacation, Professor W. O. Crosby described the geology of the region known as "Paradise," near Newport, R. I. It had previously been studied by several geologists, the latest being Mr. Dale. The chief points brought out were that the middle ridges of the region were not stratified rocks as they had usually been regarded, but intrusion veins. This fact necessarily changed the veins of the axes of the stratified slates forming the outer ridges.

Professor Wm. T. Sedgwick exhibited some apparatus recently devised at the Institute of Technology for elementary teaching

of some facts in human physiology. There were models to show the various proportions of water, proteids, fats, etc., in the human body, and in the daily income and outgo. Then in bottles were shown the relative proportions of the same constituents in milk, butter, meal, etc.; while charts illustrated the comparative food value of twenty-five cents' worth of some forty common food stuffs. Incidentally it was brought out that the pork and beans for which Boston is so celebrated, was a natural dish and one which could hardly be excelled for nutritious qualities, while oleomargarine is a benefit to all mankind, the farmers excepted. The apparatus will doubtless prove of great value in conveying to pupils in our common schools a knowledge of just those principles of physiology which will be of the most value in after life.

Oct. 20.—Mr. S. H. Scudder described the mode of life of a fossil beetle.

Nov. 3—Mr. James H. Emerton described the anatomical changes undergone by the milkweed butterfly in its chrysalis stage; and also spoke of the flying spiders on Boston common.

Nov. 17.—Dr. George L. Goodale reviewed recent investigations relative to the absorption of coloring matter by living vegetable cells.

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